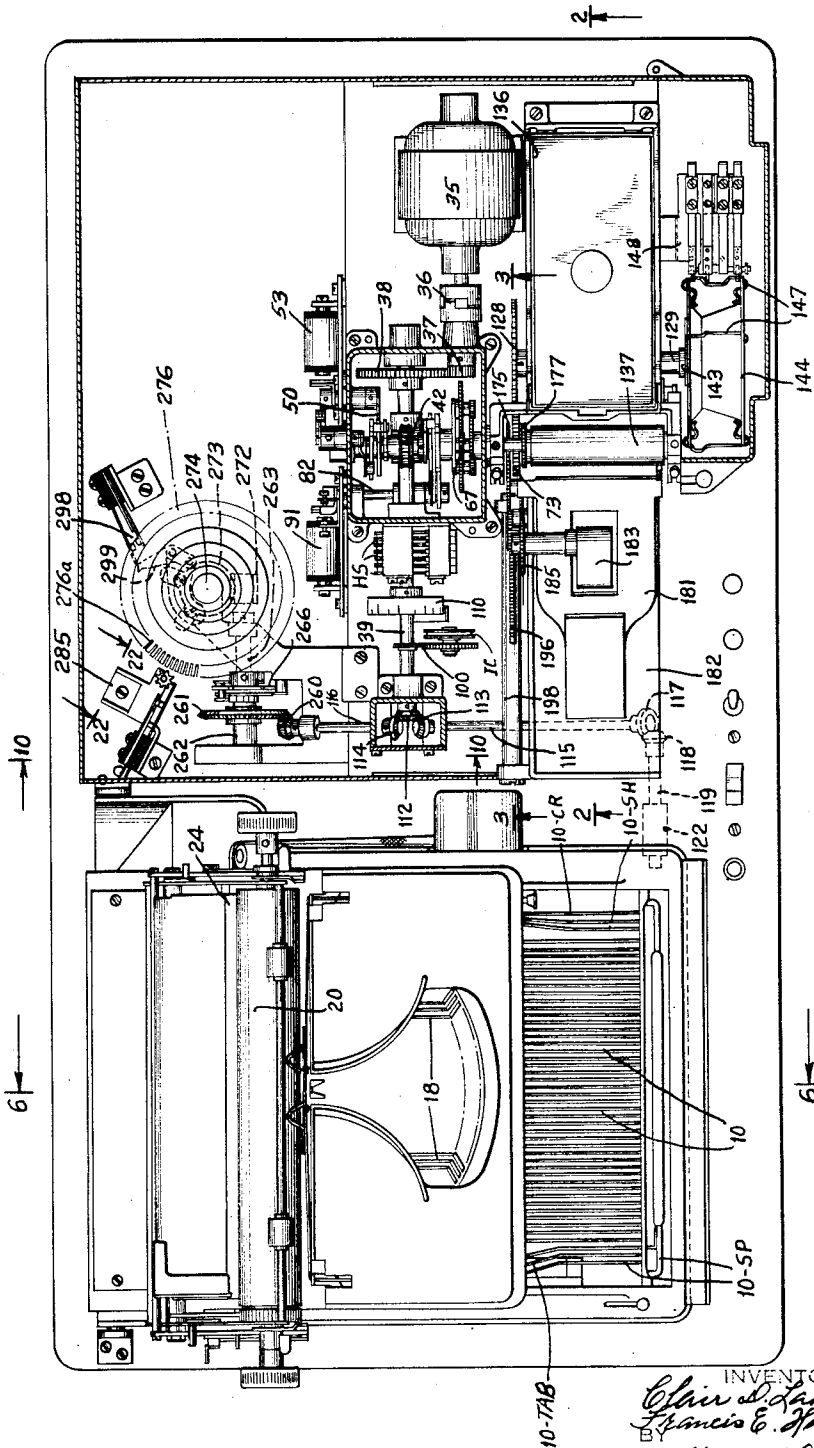


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RECORDING MACHINE

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INVENTORS
Clair D. Lake
Francis E. Hamilton
 BY *Wm. Wilson*
 ATTORNEY

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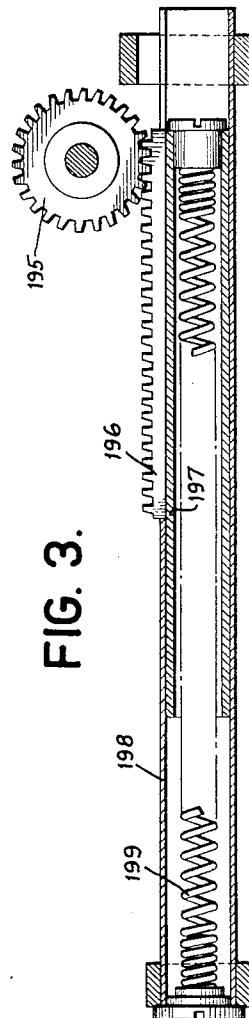
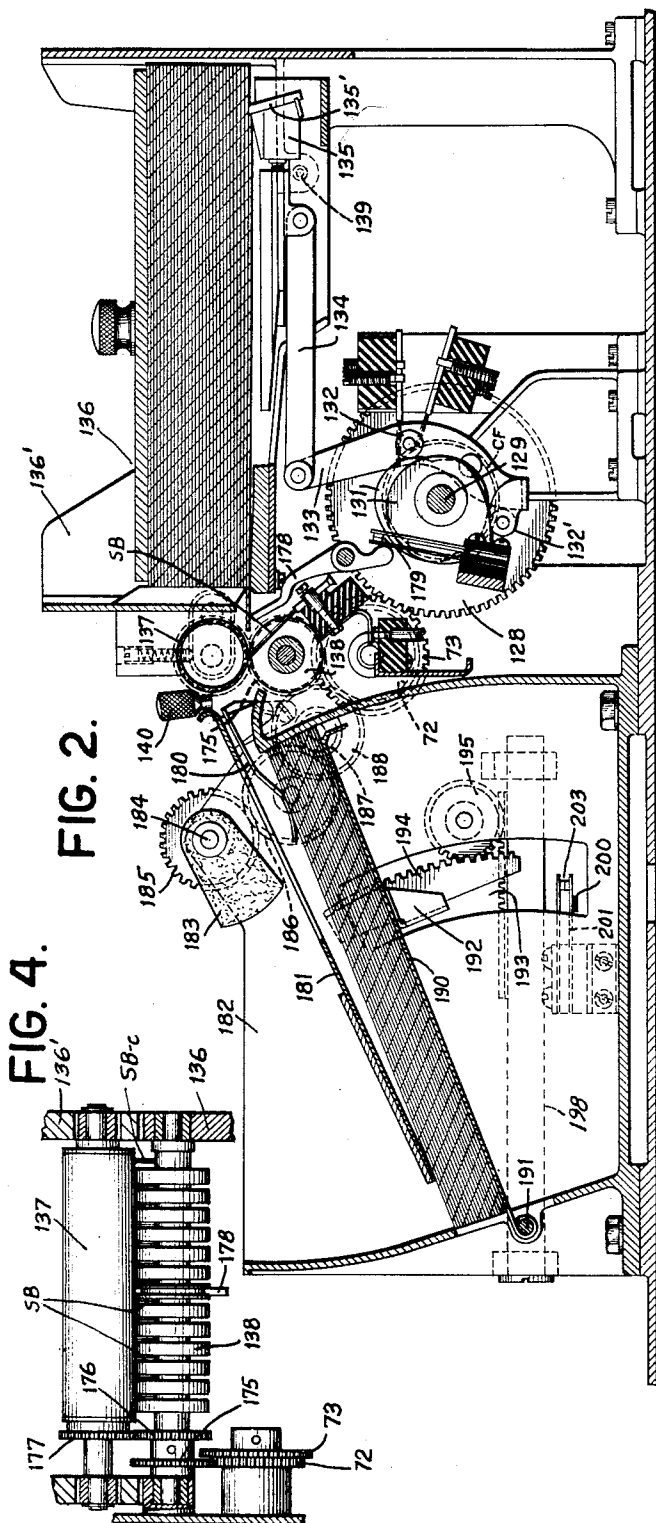


FIG. 3.

FIG. 4.

INVENTORS
Clair D. Lake
Francis C. Hamilton
BY *W. M. Wilson*
ATTORNEY

Sept. 2, 1941.

C. D. LAKE ET AL

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5. 6. 7.

INVENTORS
Claw Lake
Francis E. Hamlin
W. Musilow
ATTORNEY

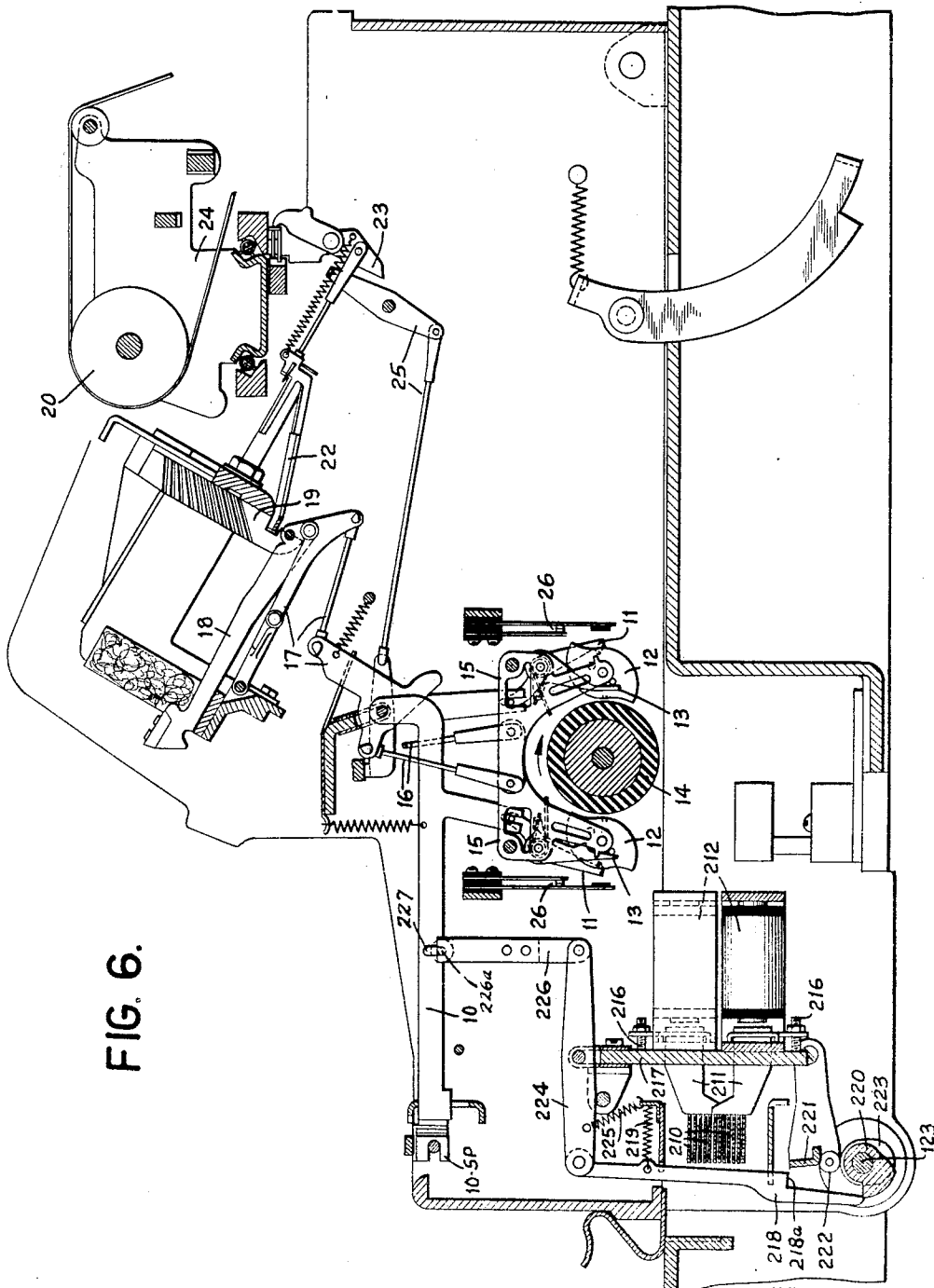


Fig. 6.

INVENTORS
Clair D. Lake
Francis E. Hamilton
BY
Wm. Gibson
ATTORNEY

Sept. 2, 1941.

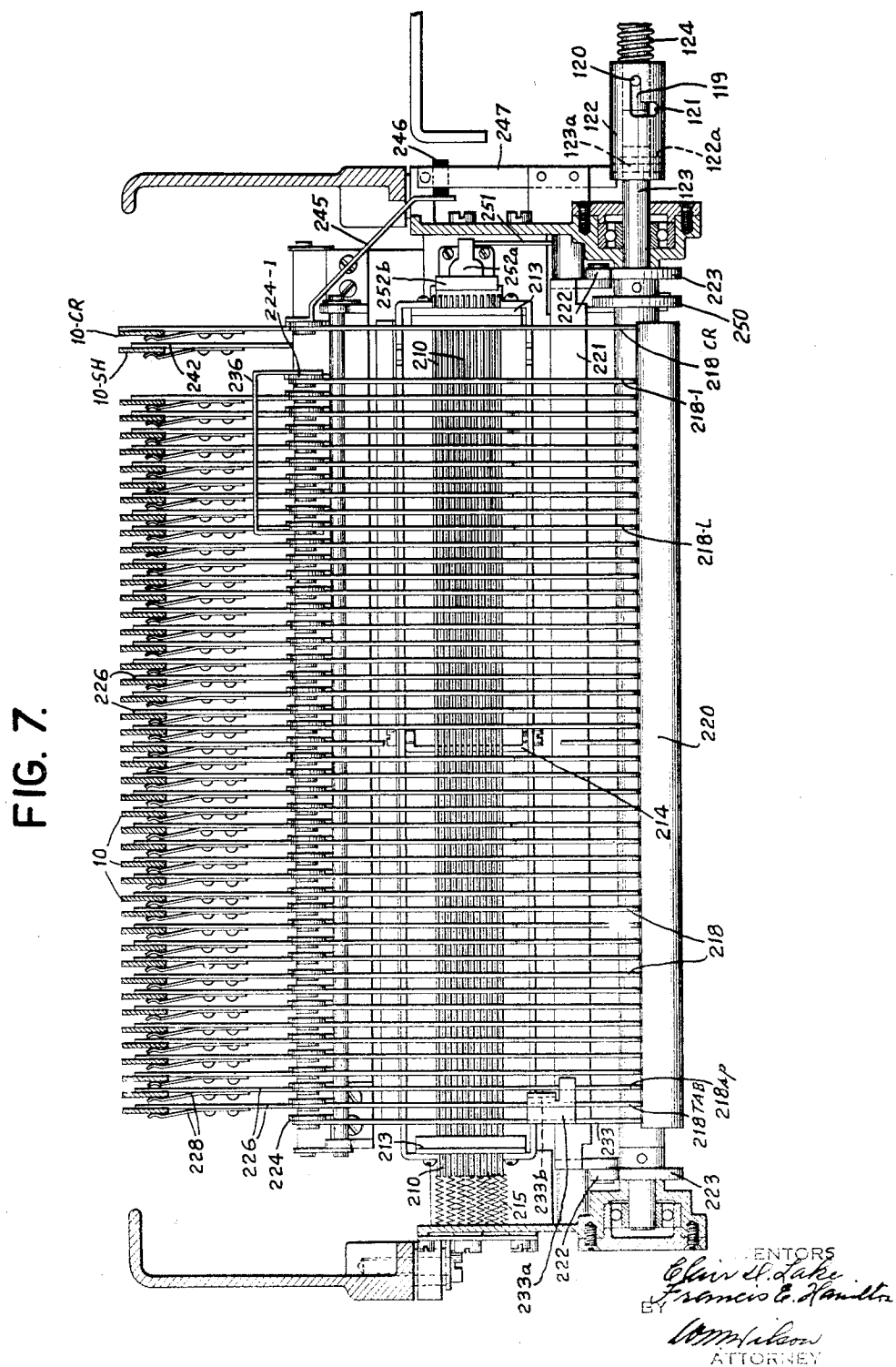
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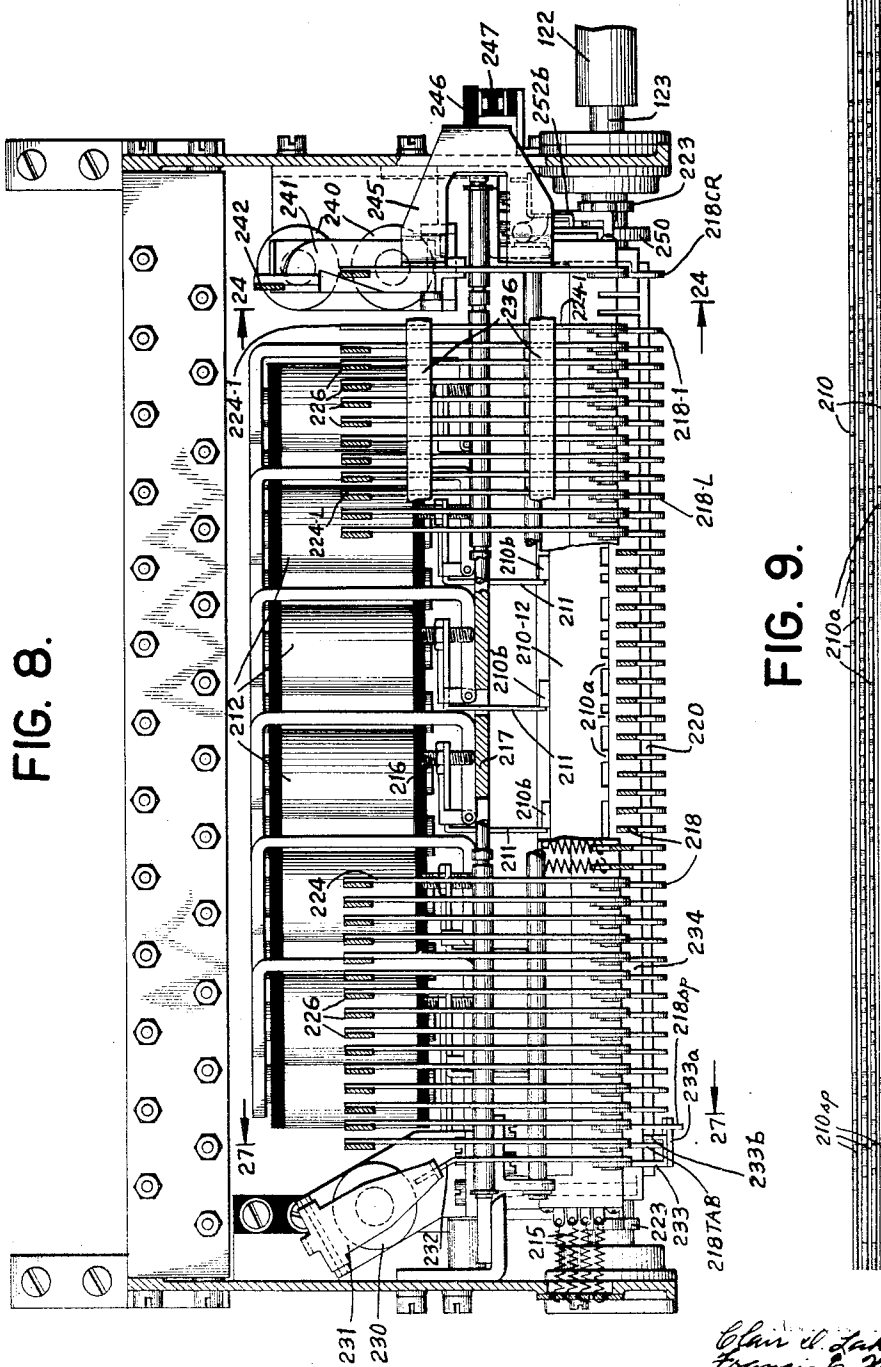


Fig. 9.

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 Clara C. Lake
 Francis C. Hamilton
 W. M. Wilson
 ATTORNEYS

Sept. 2, 1941.

C. D. LAKE ET AL

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FIG. 10.

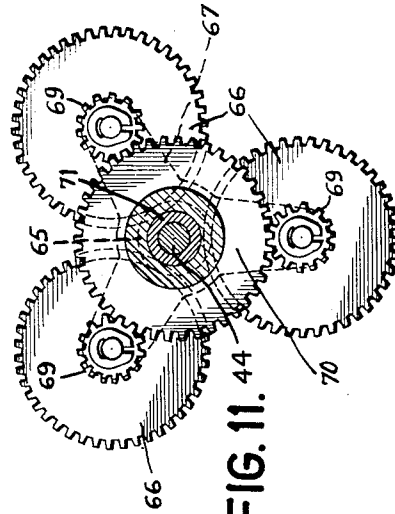
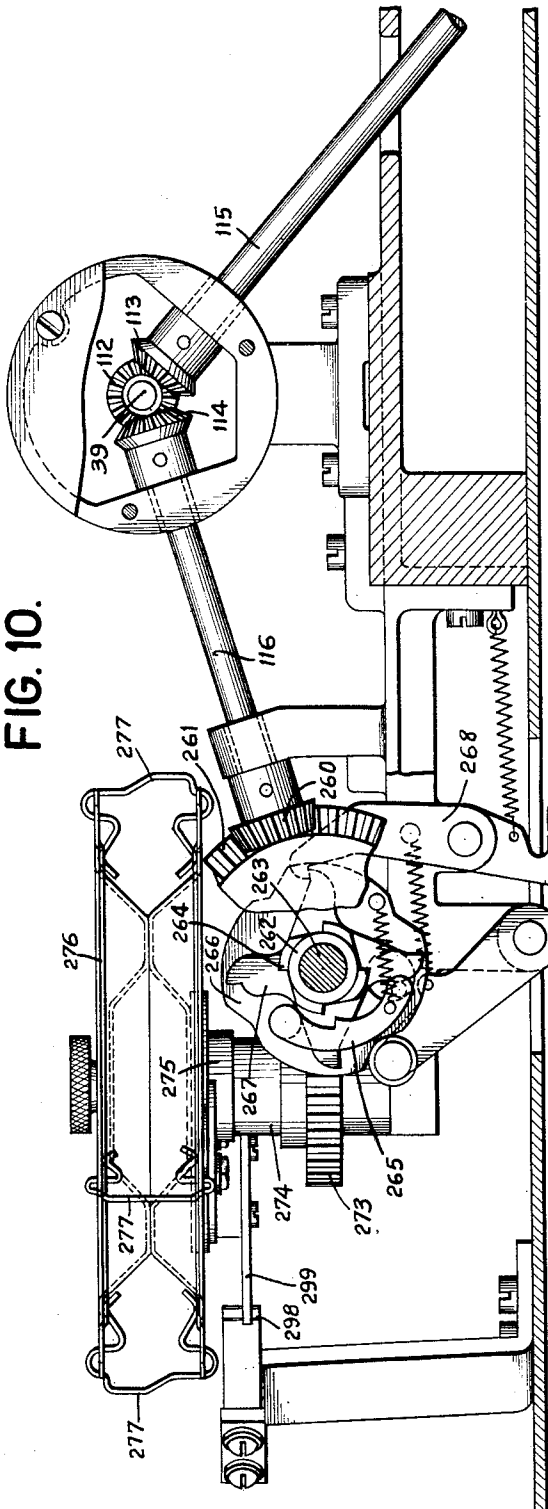
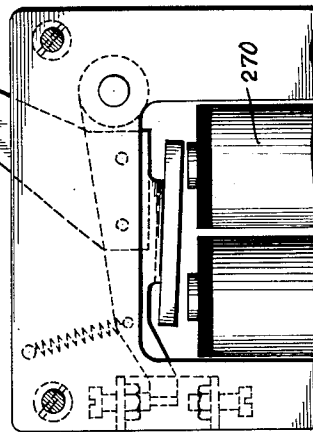


FIG. 11.



INVENTORS
C. D. Lake
Francis C. Hamilton
BY
W. M. Wilson
ATTORNEY

Sept. 2, 1941.

C. D. LAKE ET AL

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FIG. 12.

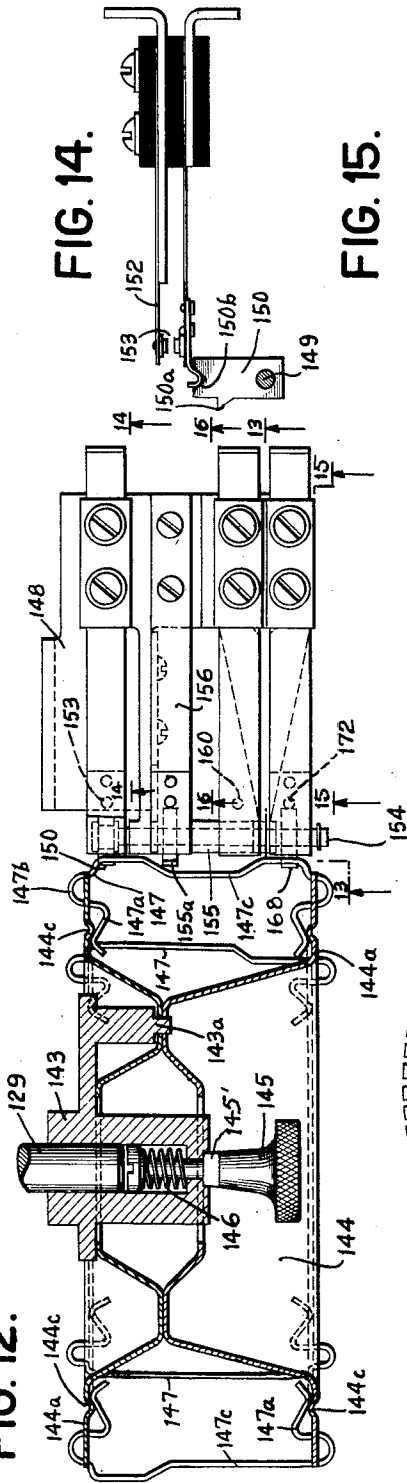


FIG. 14.

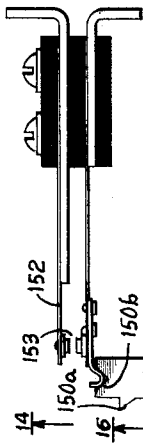


FIG. 15.

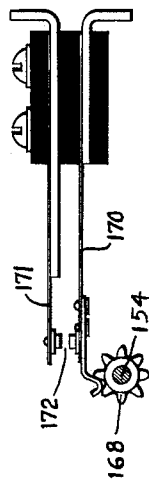


FIG. 13.

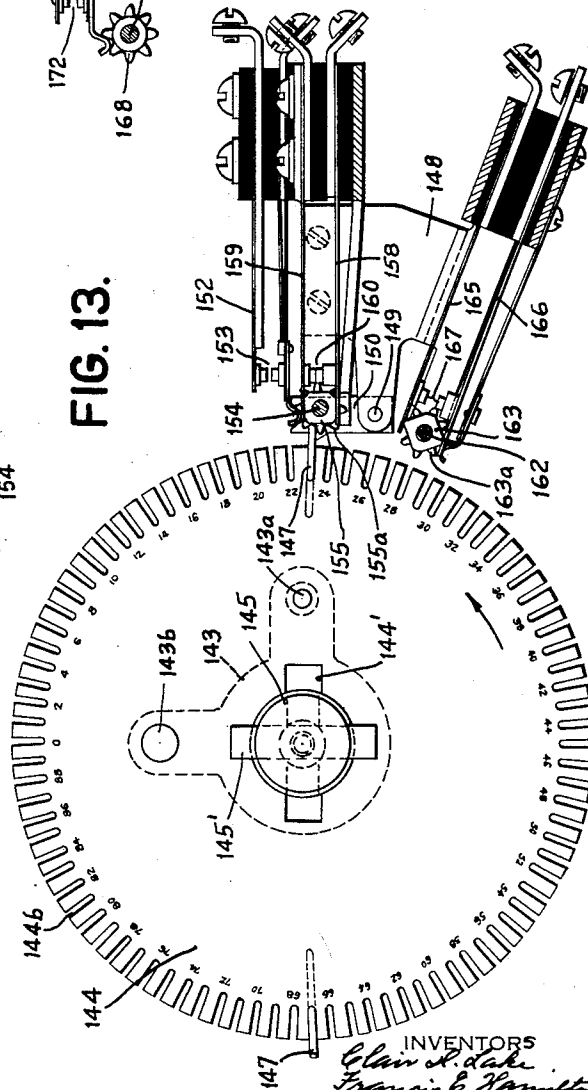
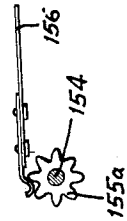


FIG. 16.



INVENTORS
Clair D. Lake
Francis E. Hammett
BY
W. M. Wilson
ATTORNEY

Sept. 2, 1941.

C. D. LAKE ET AL

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FIG. 17.

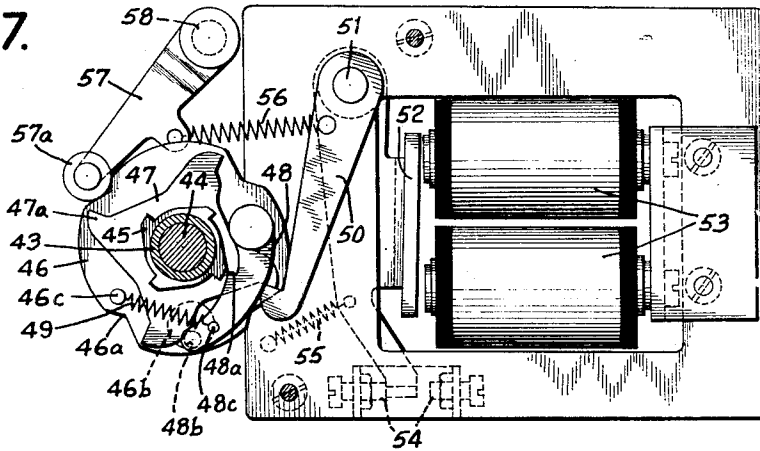


FIG. 18.

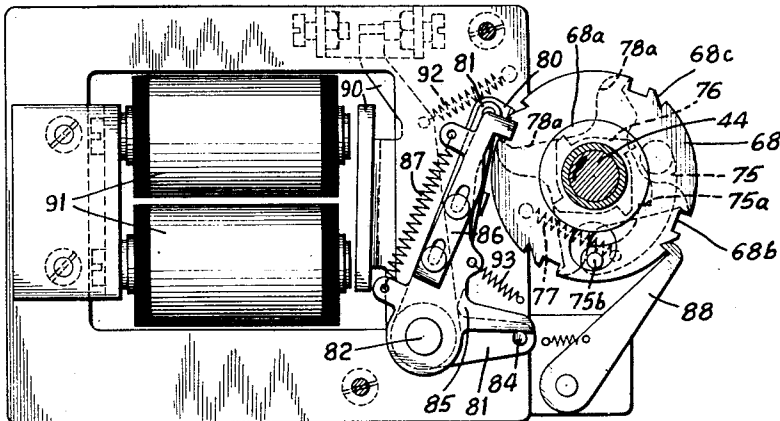


FIG. 19.

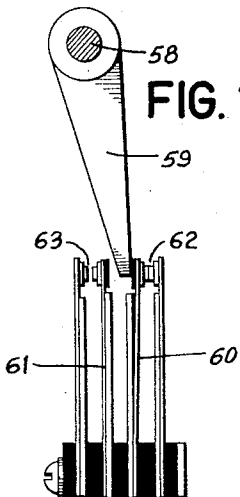
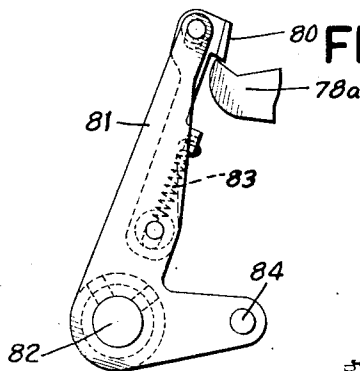


FIG. 20.



INVENTORS
C. D. Lake
Francis C. Hamilton
BY *W. M. Wilson*
ATTORNEY

Sept. 2, 1941.

C. D. LAKE ET AL

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FIG. 21.

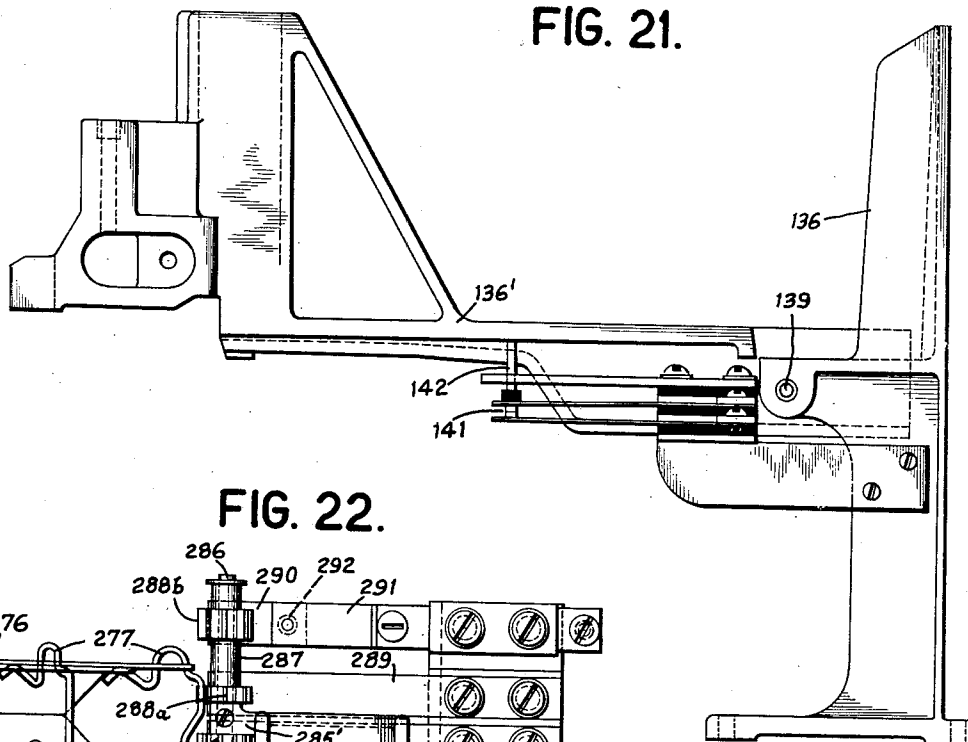


FIG. 22.

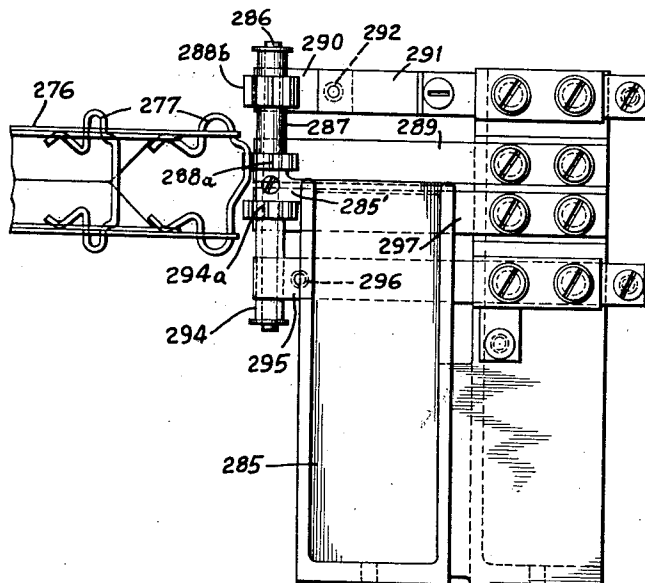
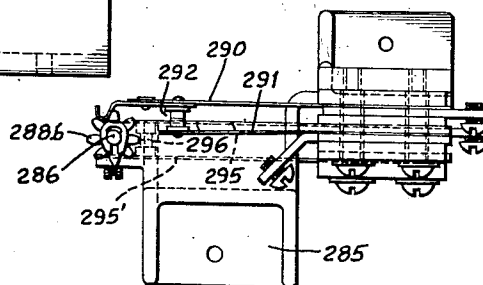


FIG. 23.



INVENTORS
Clara D. Lake
Francis C. Hamilton
BY *Wm. Wilson*
ATTORNEY

Sept. 2, 1941.

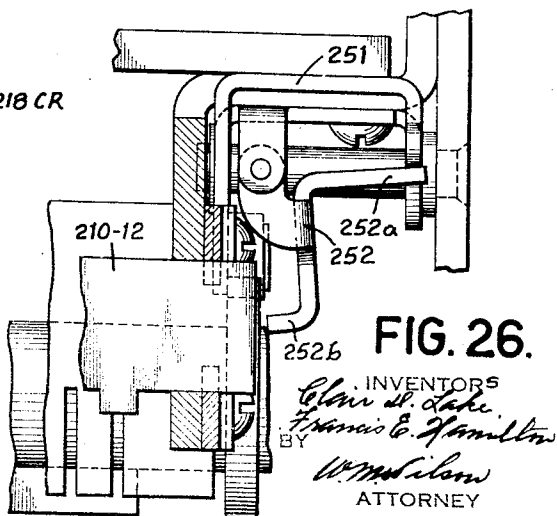
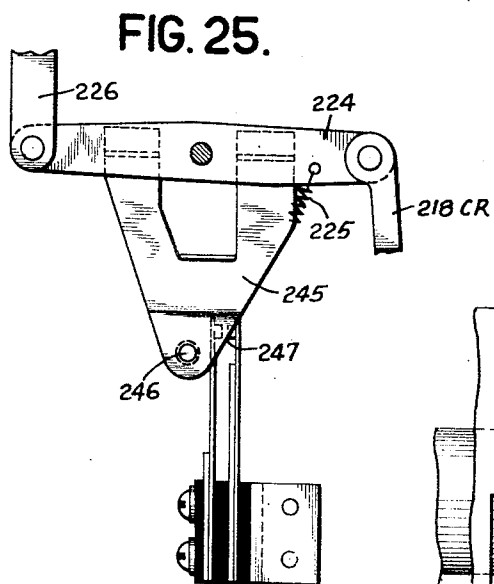
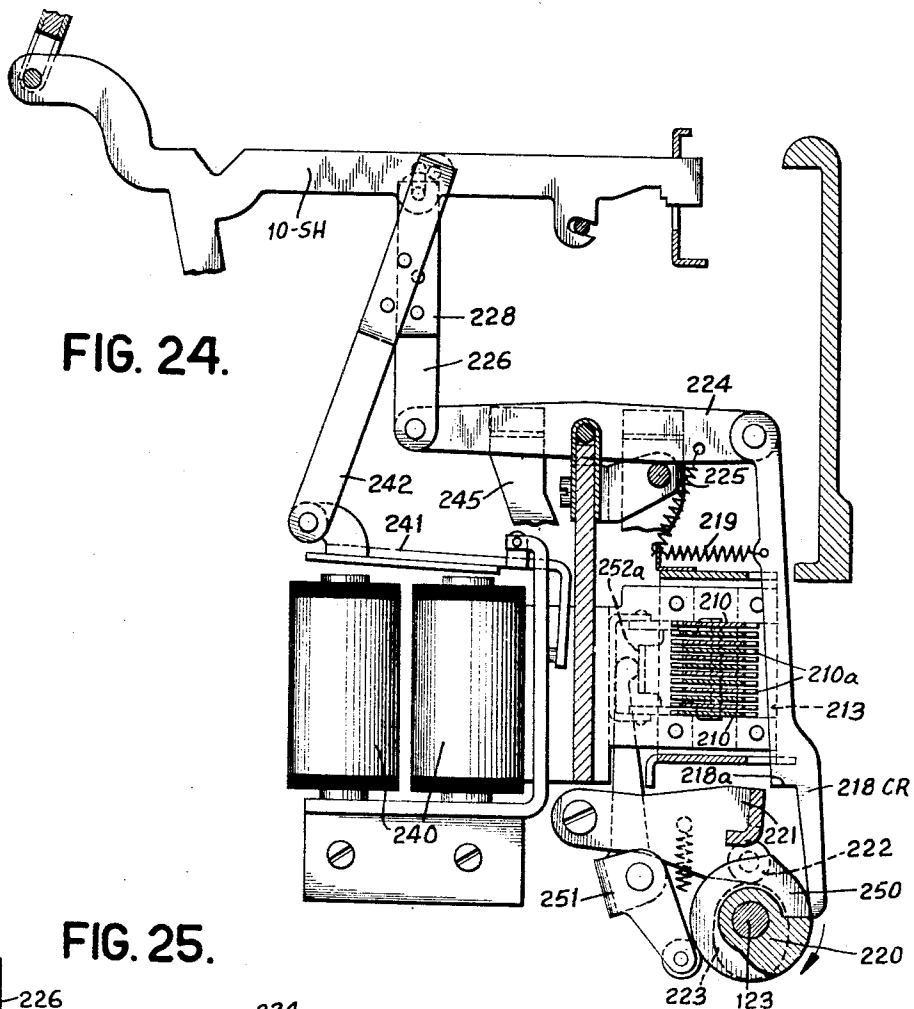
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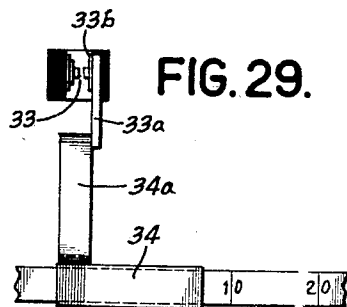
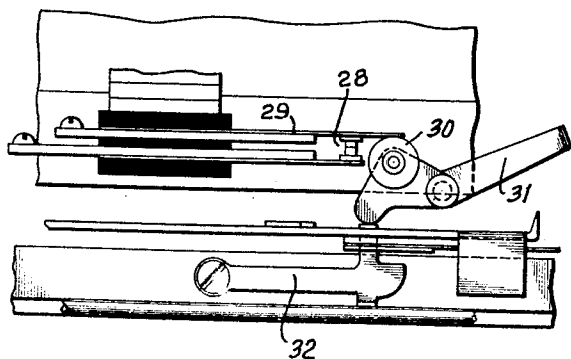
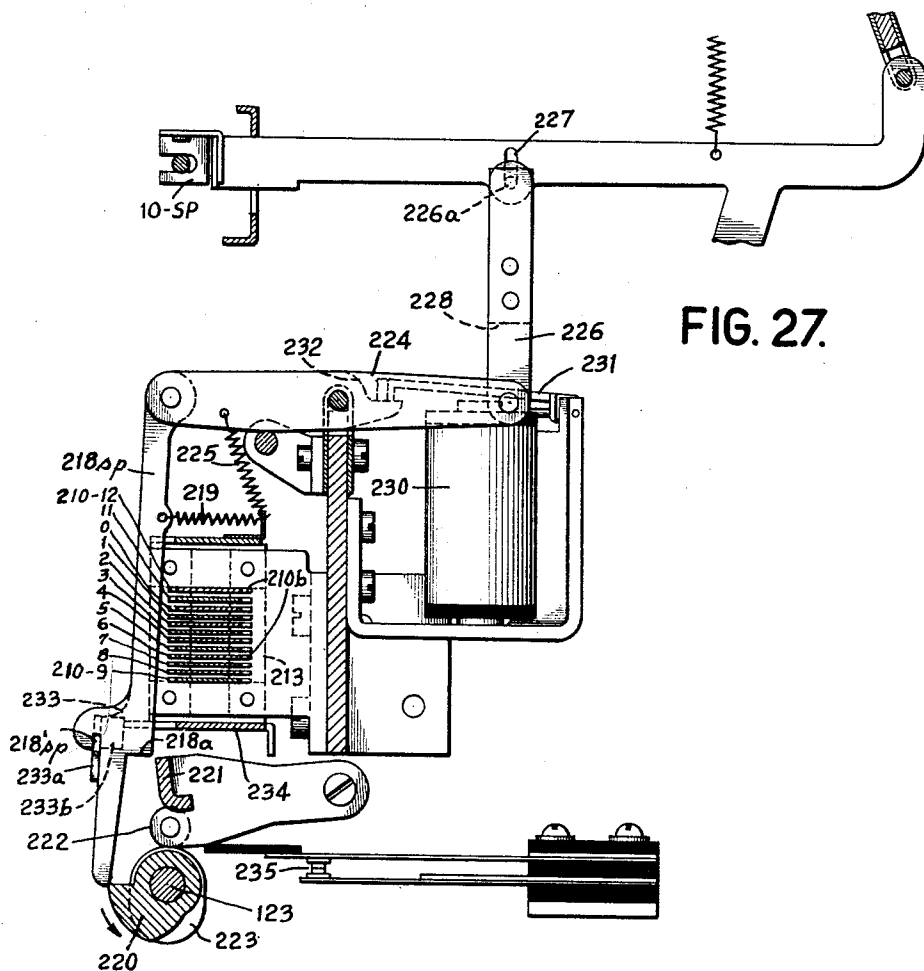
C. D. LAKE ET AL

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INVENTORS
Claude D. Lake
Francis C. Hamilton
BY *W. M. Wilson*
ATTORNEY

Sept. 2, 1941.

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FIG. 31.

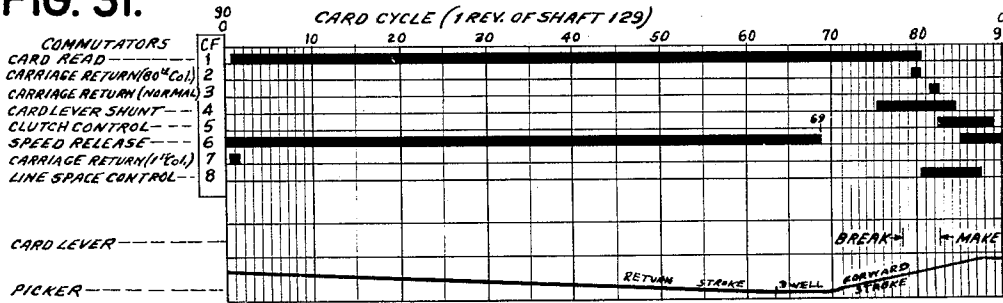


FIG. 32.

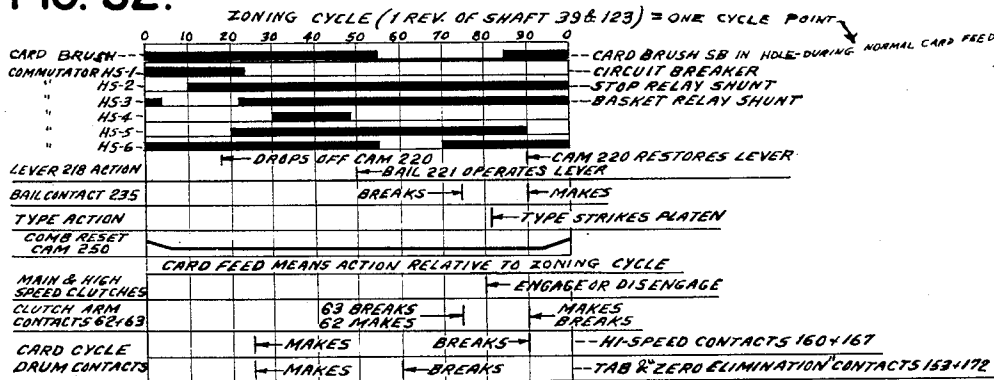


FIG. 33.

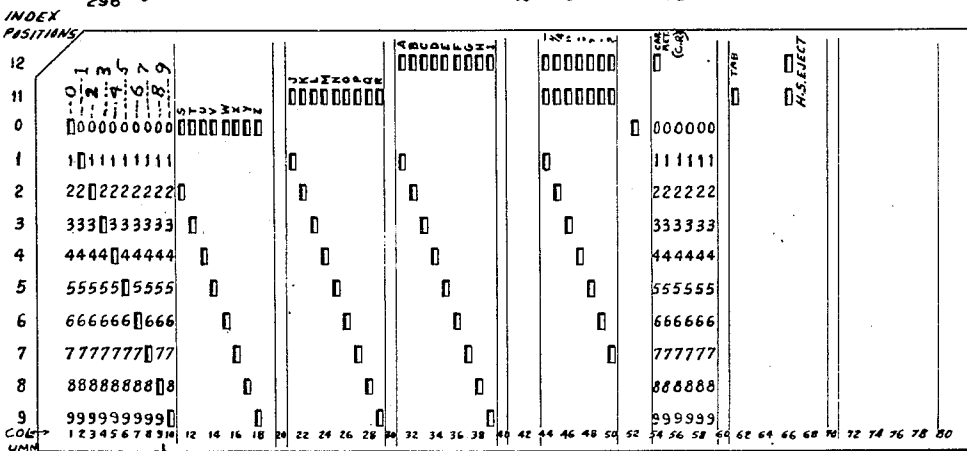
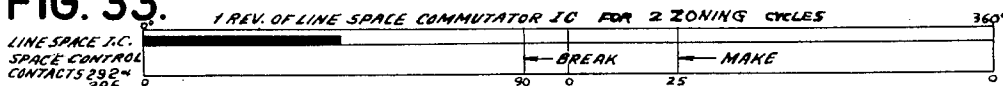


FIG. 30.

INVENTORS
C. D. Lake
Francis C. Hamilton
 ATTORNEY

Sept. 2, 1941.

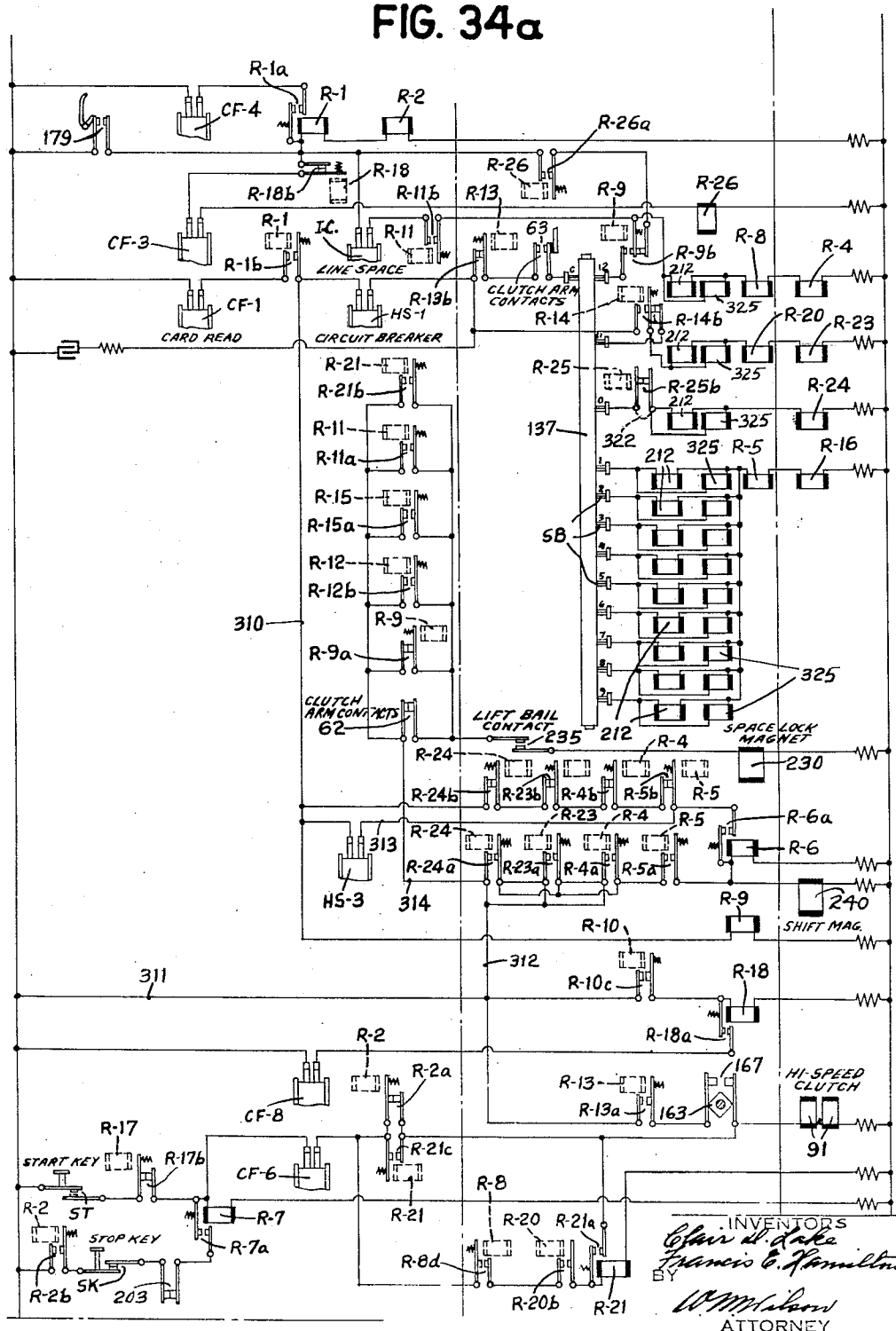
C. D. LAKE ET AL

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FIG. 34_a

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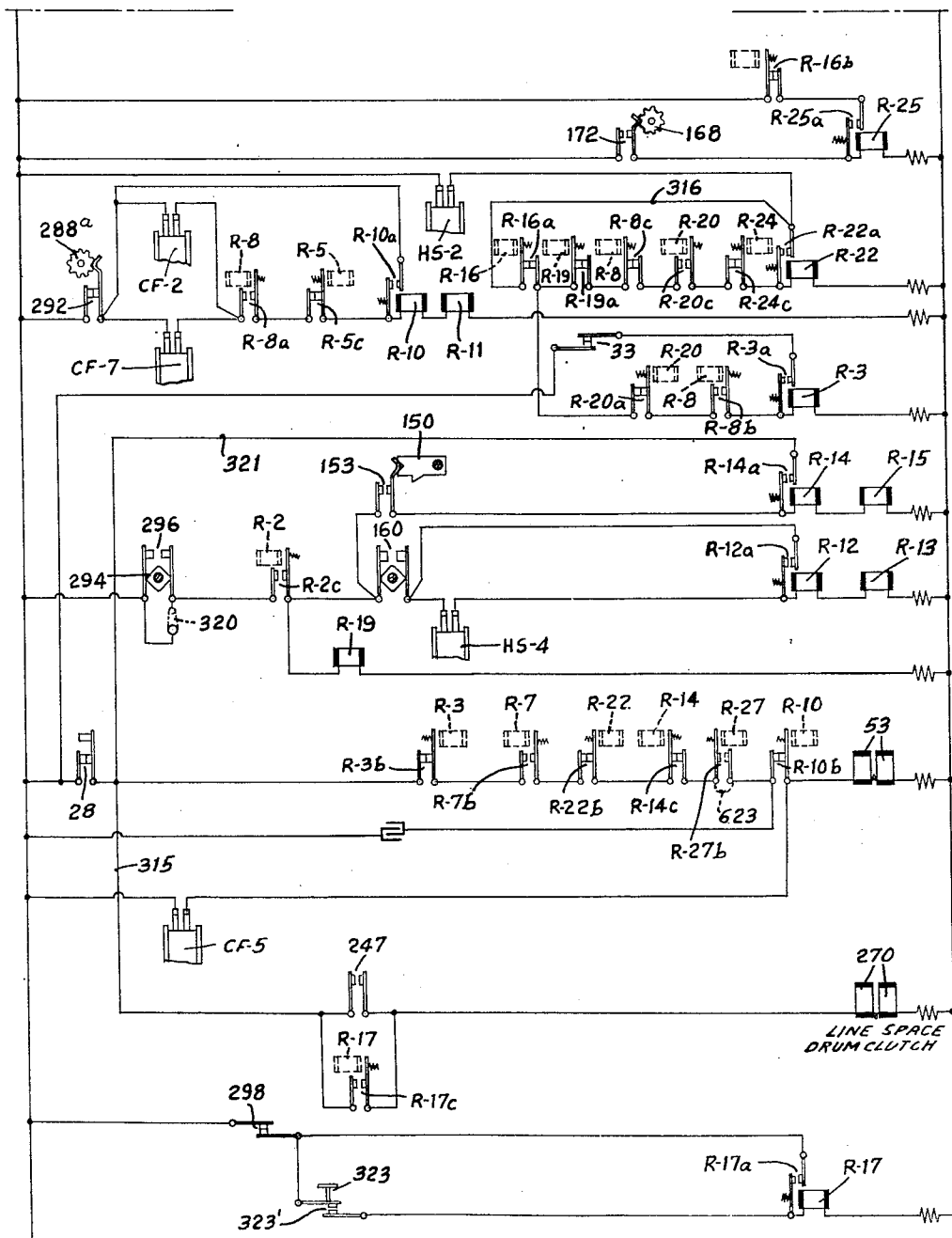
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FIG. 34b.



INVENTORS
Clair D. Lake
Francis C. Hamilton
BY *Wm. H. Brown*
ATTORNEY

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FIG. 34c.

327b-11 327b-0
"12" ZONE LINE

26 328

327b-12 327c-0
327-12 327-0
"11" ZONE LINE

327c-12 327c-11
327-12 327-11
"0" ZONE LINE

326 R-6 R-6b

HS-5

HS-6

325-12-- 327a-12 327-12
325a-12

325-11-- 327a-11 327-11
325a-11

325-0-- 327a-0 327-0
325c-0

R-27a R-27

325b 325-325'

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SW

INVENTORS
Glen S. Lake
Francis C. Hamill
BY
W. Wilson
ATTORNEY

INVENTORS
Clair D. Lake
Francis C. Hamilton
BY
W. M. Wilson
ATTORNEY

UNITED STATES PATENT OFFICE.

2,255,011

RECORDING MACHINE

Clair D. Lake, Binghamton, and Francis E. Hamilton, Endicott, N. Y., assignors to International Business Machines Corporation, New York, N. Y., a corporation of New York

Application August 31, 1938, Serial No. 227,784

32 Claims. (Cl. 197—20)

This case relates to a machine for automatically recording or transcribing information derived from an information or record source.

The present invention deals specifically with an information source comprising a record sheet or tabulating cards bearing information in the form of coded perforations or designations. The information designated on the record sheet or cards may be of the kind to be recorded in the form of lists with or without the accompaniment of heading or classification or identifying data. Thus, it may be required to prepare bills, invoices, or the like under control of the record sheet or cards, all or some of which bear the data to be listed on the invoice, bill, or statement. The listed information is required to be recorded in segregated or laterally separated lists.

One purpose of the present invention is to provide automatic list segregating or separating means for effecting predetermined list separation or division. Thus, if a series of bills is to be prepared, all of which include names of separate items, quantity of items, individual item prices, and total cost of the number of each item, the machine may be set to allocate each of these separate classes of information to a separate list.

It is further proposed to provide a cyclically operating machine operable once each cycle on a record card and including therein cyclically operating means for predetermining list separation.

It is further proposed to provide automatic list determining or spacing means operating independently of any information or designations derived from the record source.

It is still further proposed to provide list determining means operating according to a pre-selected program.

More specifically, it is proposed to provide means for determining the list arrangement in the form of a program device; for example, a program drum, having settable elements to determine the list separation.

It is also contemplated to provide for suppressing automatically the operation of the list determining means during the recording of a certain class or group of information or during the operation of the machine under control of or while deriving information from certain records.

More specifically, in the preparation of invoices, statements, bills, or the like having classification or heading information or the like to identify or accompany the information to be listed, it is proposed to provide for suppression

of operation of the list spacing or determining means.

The list separation is effected by spacing along a line of recording or by an intraline spacing, and broadly, the invention also contemplates suppression of normally effective intraline spacing controls during the recording of information derived from certain records.

Another object of the invention is to provide for automatic skipping of intermediate or end fields of a record sheet at greater than the normal speed of operation.

In connection with the latter object an object is to selectively suppress the high speed skip control when certain record cards are being operated on.

The object is further to provide program means for selectively determining the operation of the high speed skip means.

It is also an object to provide a novel means for controlling longitudinal or line spacing of the record form which receives the transcription of the data taken from the record cards.

More specifically the latter object includes the provision of program means for automatically determining line spacing operations.

This object, stated more broadly, contemplates the provision of program means for controlling the extent of vertical spacing between different data fields of a record form on which the items derived from the data bearing medium are being recorded.

It is an object further to provide novel means for translating the coded data designations of record cards into operations of a recording apparatus.

It is still another object to provide novel means for selectively operating the same recording element under control of different codes.

Further objects of the instant invention reside in any novel feature of construction or operation or novel combination of parts present in the embodiment of the invention described and shown in the accompanying drawings whether within or without the scope of the appended claims and irrespective of other specific statements as to the scope of the invention contained herein.

In the drawings:

Fig. 1 is a plan view of the machine, with the control section uncovered.

Fig. 2 is a section along lines 2—2 of Fig. 1.

Fig. 3 is a detail sectional view through a part of the card stacking unit of the control section, taken along lines 3—3 of Fig. 1.

Fig. 4 is a detail view of part of the analyzer for the cards.

Fig. 5 is an enlarged plan view of the drive mechanism and part of the control section.

Fig. 6 is an enlarged side section through the transcribing section, taken along lines 6—6 of Fig. 1.

Fig. 7 is a front, sectional view of the translating portion of the transcribing section.

Fig. 8 is a top, sectional view of the translating portion.

Fig. 9 shows, in front view, the top four combs of the translating portion.

Fig. 10 is a sectional view of the line space program means, taken along lines 10—10 of Fig. 1.

Fig. 11 is a sectional view of planetary gearing forming part of the drive mechanism, taken along lines 11—11 of Fig. 5.

Fig. 12 is a plan section through the card cycle program drum, and also showing the associated contact means.

Figs. 13, 14, 15, and 16 are sections taken along lines 13—13, 14—14, 15—15, and 16—16 of Fig. 12.

Fig. 17 is a detail side sectional view of the main clutch and its control magnet.

Fig. 18 is a detail, side sectional view of the high speed clutch and magnet.

Fig. 19 is a detail view of contacts controlled by an arm of the main clutch assembly.

Fig. 20 is a detail view of the high speed clutch detent.

Fig. 21 is a detail side view of the card supply hopper.

Fig. 22 is a rear view of part of the line space program means, taken as indicated by arrows 22—22 of Fig. 1.

Fig. 23 is a top view of the line space program contact assembly.

Fig. 24 is a side section through the zoning system, showing the shift lever control magnet, and taken along lines 24—24 of Fig. 8.

Fig. 25 is a detail of line space control clutch contacts in the zoning system.

Fig. 26 is a detail view of restoring means for the combs of the zoning system.

Fig. 27 is a section taken along lines 27—27 of Fig. 8.

Fig. 28 is a detail plan view of switch means in the recording unit and controlled by the carriage return or tabular operating levers.

Fig. 29 is a detail plan view of contacts controlled by a left hand margin stop in the recording unit.

Fig. 30 shows a record or tabulating card punched with the codes for the various functions.

Fig. 31 is a timing chart of the card cycle.

Fig. 32 is a timing chart of a card column cycle, with an indication of the timing of the various card cycle program contacts in relation to the column cycle.

Fig. 33 shows the timing of a line space commutator contact, and indicates in relation thereto the timing of line space program contacts, and

Figs. 34a, b, and c are the circuit diagram.

The invention, though capable of varied applications, is disclosed herein in conjunction with the preparation of invoices or the like, the data for which is taken from perforated record cards. It is to be understood that the invention may be applied to the preparation of other forms of records; further, that the invention may be used in conjunction with codes derived from a record tape or sheet or from a remote source, either

through electrical, pneumatic, or equivalent circuit means or through mechanical means.

GENERAL DESCRIPTION

The machine may be considered to comprise a control section including card handling and reading means, and a transcribing section including translating means or a zoning system and a recording or writing unit. Common to both sections is a drive mechanism. This mechanism, acting through a main clutch, operates cyclical means in the control section, having one cycle for each card. A high speed clutch supplements the main clutch, so as to enable certain parts of a card, during a cycle to be ejected rapidly. Where the stack of cards to be transcribed has the same class of data assigned to the same predetermined parts of each card, the separation of the different classes of items into segregated lists is controlled by program means which acts during each card cycle to control tabular mechanism of the transcribing unit to laterally space the classes of items. This program means also may control high speed operation of the control section, as well as zero elimination means to prevent printing of zeros to the left of the first significant digit of a numerical amount transcribed from the record card.

When the machine is preparing invoices including headings, certain of the cards bear the heading data. During the cycles of action on the heading cards, the tabular control by the card cycle program means and high speed control by the same program means are suppressed. This suppression is controlled by program means governed by operation of the transcribing unit in accordance with the longitudinal feed of the invoice sheet, and the latter program means may be referred to as the line space program means. Another, and important, function of the line space program means is to control the amount of longitudinal spacing between different groups of data. Thus, a predetermined number of lines is assigned to each invoice form, with the heading to be within a heading field, the item lists to lie within an item field, and the total to be recorded on a total line. The spacing between the various fields of each invoice form, as well as the spacing between the total line or field of one invoice and the heading field of the next invoice are all controlled by the line space program means.

The cards to be transcribed are placed in a supply hopper in the control section in the order in which their data are to be recorded. Also, the cards are disposed with their designation columns extending transversely to the direction of feed and so as to successively traverse the designation analyzing means. As the analyzing means reads a designation, it controls the zoning system accordingly to cause the recording unit to record the designation, or controls the machine to function in accordance with the designation.

The drive mechanism continuously operates actuating mechanism in the transcribing section at high speed relative to the normal speed of the operating means in the control section. Each cycle of the control section takes care of one card while each cycle of the zoning system takes care of one designation column of the card. The control section cycle may be referred to as the card cycle, while the zoning system cycle may be referred to as the column cycle.

A detail description follows.

THE TRANSCRIBING UNIT

While the invention may make use of any suitable recording unit, it is preferred, for illustrative purposes, to disclose the invention herein in connection with a recording apparatus, the general principles of which are disclosed in Patents Nos. 1,777,055 and 1,873,512. Fig. 1 shows the arrangement of levers 10 for causing the operation of transcribing elements and related control devices. The several levers 10 may be distinguished by appending to the general reference character a supplementary reference character denoting the particular function or operation controlled by the operating lever. Thus, levers 10—A to Z, 0 to 9, cause operation of transcribing elements to record characters A—Z, 0 to 9; lever 10—TAB controls tabulating operation; lever 10—SH controls the form in which the character is to be recorded, that is, whether the character is to be recorded in upper or lower case; lever 10—CR controls the carriage return operation; and lever 10—SP controls the operation of intraline spacing means.

Referring to Fig. 6, depression of a lever 10 releases a latch 11 from a cam 12 permitting the latter to be forced by a lever 13 against a constantly rotating friction shaft 14. The latter rotates the cam, causing the carrier 15 of the cam to rock in a direction for depressing connected link 16. This link, through a linkage 17, propels a type bar 18, mounted on type basket 19, against the sheet of paper on the platen 20, thereby typing the character corresponding to the depressed lever 10. During the end of the stroke of type bar 18, it strikes a universal bar 22 to actuate the escapement control 23 for effecting a character or intraline spacing operation of the carriage 24. Operation of the space lever 10—SP acts through associated elements 11, 12, 13, 15, and 16 to operate a linkage 25 for actuating escapement control 23 to cause an intraline spacing operation of carriage 24.

The carriage return means operated by lever 10—CR may be such as disclosed in Patent 1,955,614. As usual, the carriage return is preceded by a line spacing operation, and after the carriage has returned to the beginning of the line, repeat depressions of the lever 10—CR will effect repeat line spacing operations.

The tabulating means may be such as disclosed in Patent 1,935,436, and includes the usual settable tabular stops set in accordance with a desired lateral spacing of item lists and other information across the record sheet. Depression of the lever 10—TAB controls the tabular spacing as governed by the positions of the tab stops.

Peculiar to the present invention are the following:

Normally closed switches 26 (Fig. 6), one associated with each cam 12, are provided to be used in checking the accuracy of transcription of the card data, in a manner which will be explained hereinafter. When a lever 10 is depressed to cause release of cam 12 associated therewith, the rotor 14 imparts half a turn to the cam to cause operation of the type bar. During this movement of cam 12, it rides past the long blade of the associated switch 26 and momentarily opens the latter.

A special normally closed switch 28 (Fig. 28) is located at the rear of the recording unit. The long, spring blade of this switch is engaged with a roller 30, of insulating material, carried by one arm of a lever 31. This lever is the back-space

interlock, which as described in Patent 1,873,553 is rocked by the escapement pawl release lever 32 while the carriage is tabulating. Lever 32 is also actuated during line space or carriage return operation to rock back-space interlock lever 31, as described in above-mentioned Patent 1,955,614. When the lever 31 is rocked, its roller 30 opens switch 28, which remains open until the completion of either the carriage return or the tabulating operation, whichever is taking place. The purpose of switch 28 will be explained hereinafter, in connection with the circuits.

Another special, normally closed switch 33 is provided (Fig. 29) at the rear of the recording unit, which is opened when an insulating tab 33a on its long, spring blade 33b is engaged by the special extension 34a of the settable "beginning of the line" margin stop 34. The purpose of switch 33 will be explained in connection with the circuits.

Record card and code

The record card T, as indicated in Fig. 30, has eighty designation columns, each with twelve index points or perforation-receiving positions known as the 9, 8 . . . 1, 0, 11, and 12 positions, and perforations in which are known as the 9, 8 . . . 1, 0, 11, and 12 perforations.

The columns of a card T are perforated according to the information to be listed or transcribed under control of the card, and the various codes designating the information are shown in Fig. 30. The codes may be considered as divided into several zones. The single point zone includes single perforations in any of the 9, 8 . . . 1, 0, 11, and 12 positions of a card column. The 9, 8 . . . 1, 0 perforations in this zone represent, respectively, these numerals, the 11 perforation represents a tabular operation, and the 12 perforation represents a carriage return operation. The 12 zone comprises a common 12 perforation plus one of the perforations 1 to 9 representing letters A to I. The 11 zone comprises the common 11 perforation plus one of the 1 to 9 perforations, representing letters J to R. The 0 zone comprises the common 0 perforation accompanied by a 2 to 9 perforation representing letters S to Z. The 11—12 zone comprises common 11—12 perforations plus a 1 to 7 perforation, representing different symbols. The 11—12 code alone represents a high speed (H. S.) eject operation to be controlled by the card. In each combination hole code, the common zone perforation or perforations may be referred to as the zone distinguishing perforation, point, or characteristic. In the single point zone, the imperforate or solid portion of the column may be considered as the zone characteristic. The character or function distinguishing points of each zone are the 1 to 9 perforations which may be referred to as the intrazone points or characteristics.

Drive mechanism

Referring to Figs. 1 and 5, the drive mechanism includes a motor 35. Motor 35 through a coupling 36 rotates a pinion 37 which drives a gear 38 on a shaft 39 carrying a worm 40. Worm 40 meshes with a worm wheel 42 on a sleeve shaft 43 rotatably mounted on a shaft 44.

Main clutch.—One end of the sleeve shaft 43 is provided with a driving clutch ratchet 45 (also see Fig. 17) having four teeth, ninety degrees apart. Fixed to shaft 44, adjacent driving ratchet 45, is a plate 46 formed with four equally spaced notches 46a ninety degrees apart.

Loosely carried by shaft 44 adjacent plate 46, is a cam disk 47 with four cam teeth 47a, each adjacent one notch 46. Plate 46 pivotally carries a clutch pawl 48 having an intermediate tooth 48a to engage a tooth of driving ratchet 45. The free end of pawl 48 carries a stud 48b passing through a hole 46b in plate 46. Adjacent stud 48b, pawl 48 has a pin 48c connected by a spring 49 to a pin 46c on plate 46. The spring tends to move pawl 48 inwardly to engage its tooth 48a with a tooth of driving ratchet 45, but this action is prevented while the high cam portion of a tooth 47a of disk 47 is engaging stud 48b of the pawl. The disk 47 is held in such a declutching position by engagement of the flat side of one of its teeth 47a with the nose of a latch arm 50 fixed to one end of a shaft 51 which at the opposite end carries the armature lever 52 of main clutch magnet 53. The lower, free end of armature lever 52 is located between a pair of adjustable stop screws 54 which limit the retracted and attracted positions of the armature lever, its shaft 51, and latch arm 50. A spring 55 connected to armature lever 52 and a spring 56 connected to latch arm 50 combine to hold the armature lever in retracted position, with the latch arm in position to engage a tooth of disk 47. Spring 56 connects arm 50 to an impositive latch arm 57 provided with a roller 57a riding on the periphery of disk 46, and adapted to enter a notch 46a of plate 46 to detain, impositively, this plate in one of the four positions, ninety degrees apart, at which the declutching takes effect. Arm 57 is fast to a shaft 58 which carries a dependent arm 59 (Fig. 19) located between the adjacent spring blades 60 and 61 of a pair of switches 62 and 63 tending to open. When arm 57a is seated in a notch 46a, switch 62 is closed and switch 63 open. These switches may be referred to as the clutch arm contacts. During rotation of disk 46, arm 57 will be cammed out of notch 46a, causing arm 59 to close switch 63 and permit switch 62 to open. The arm 57 will move into a notch 46a every ninety degrees of rotation of plate 46, intermittently closing switch 62 and opening switch 63.

When main clutch magnet 53 is energized, it rocks armature lever 52, shaft 51, and latch arm 50 counterclockwise (Fig. 17). The latch arm withdraws from an arm 47a, releasing cam disk 47 and enabling spring 49 to move stud 48b inwardly. The stud acts against the curved cam side of a tooth 47a of disk 47 to rock the disk clockwise, bringing the tooth 47a previously engaged by arm 50 below the nose of the latter. As pawl 48 was rocked inwardly by spring 49, its clutching tooth 48a engaged with a tooth of driving ratchet 45, thereby coupling the driven shaft 44 to the sleeve shaft 43 of the ratchet. With pawl 48 in its inner, clutching position, stud 48b thereof is seated in the crotch between two teeth of cam disk 47, forcing the latter disk to rotate with the pawl. Upon deenergization of main clutch magnet 53, latch 50 intercepts one of the four teeth of disk 47, rocking the latter to cam pawl 48 out of clutching engagement with ratchet 45. Referring to Figs. 5 and 11, driven shaft 44 rigidly carries a pinion 65, meshed with three sun gears 66 rotatably carried by the three arms of a carrier 67 which is fixed at its center to the reduced end of the hub sleeve 68a of a driven clutch disk 68. When clutch disk 68 is stationary, then carrier 67 is also at rest, and sun gears 66 are capable only of simple rotation

by pinion 65. Rigid with each gear 66 is a pinion 69 meshed with a gear 70 fast to one end of a sleeve 71 surrounding shaft 44. To the opposite end of the sleeve 71 is fast a pair of gears 72 and 73. With shaft 44 coupled, as previously explained, to driving ratchet 45 for rotation, and with driven clutch disk 68 held against movement, pinion 65 of shaft 44 actuates gearing 66, 69, 70, 72, and 73 as a simple train of gearing. Gears 72 and 73 then rotate at normal speed.

It is clear, from the above, that when main clutch magnet 53 alone is energized to cause shaft 44 to be coupled to driving ratchet 45 on the motor-driven sleeve shaft 43, the gears 72 and 73 have normal speed operation.

For convenience, clutch elements 45, 46, 47, 48 may be considered to comprise the main clutch.

The gears 72 and 73 may be driven, alternatively, at high speed. For effecting high speed drive, the following means are provided:

High speed clutch.—Referring to Figs. 5 and 18, driven clutch disk 68, previously referred to, pivotally carries a clutch dog 75 having an intermediate tooth 75a engageable with a tooth of a driving ratchet wheel 76 fixed to driven shaft 44 and similar to driving ratchet 45. As in the main clutch, clutch dog 75 has a stud 75b passing through a hole in the disk 68, and a spring 77 between the disk and the dog urges the dog inwardly, tending to engage tooth 75a with driving ratchet 76. Loosely mounted between disk 68 and ratchet 76 is a cam disk 78 having four cam teeth 78a, similarly to disk 47 of the main clutch. In the arrested position of cam disk 78, the cam side of one of its teeth 78a abuts the stud 75b, preventing clutch dog 75 from engaging its tooth 75a with ratchet 76.

Engaging the flat side of a tooth 78a of cam disk 78 is the nose of a detent 80 mounted on the vertical arm of a bell crank lever 81 fixed to one end of a shaft 82 (also see Fig. 20). Detent 80 is mounted for slight vertical play along the vertical arm of lever 81 and is normally held in lower position relative to the latter arm by a spring 83. The purpose of thus mounting detent 80 is to enable the detent when it intercepts a tooth 78a to be moved upwardly by the tooth just before the disk 78 is stopped and thus yieldingly arrest the disk, with spring 83 helping to absorb the shock of impact between the detent and a tooth 78a when the detent stops the disk 78.

The horizontal arm of lever 81 is provided with a stud 84 engaging the bottom of the horizontal arm of a latch lever 85, rotatably mounted on shaft 82 (see Fig. 18). The upper, nose-end of lever 85 is square to seat within any one of the four square notches 68b of clutch disk 68. Mounted for vertical, slidable movement on the vertical arm of lever 85 is a thin latch slide 86 urged downwardly by a spring 87 between the slide and the lever. The upper, nose end of slide 86 has the same square shape as the nose of latch lever 85 and is adapted to lie, alongside the nose of the latch lever, inside the same square notch 68b. To prevent reverse rotation of clutch disk 68, it is provided with ratchet notches 68c to receive the nose of a pawl 88 which permits clockwise or forward rotation of the clutch disk but prevents its reverse rotation.

Shaft 82, as indicated in Figs. 5 and 18, rigidly carries the armature assembly 90 of high speed clutch magnet 91. Upon energization of this magnet, armature 90 and its shaft 82 are rocked counterclockwise (Fig. 18) against resist-

ance of a spring 92, causing detent lever 81 to rock in the same direction, withdrawing detent 80 from an arm 78a of cam disk 78. As lever 81 moves counterclockwise, its stud 84 similarly rocks lever 85, and latch slide 86 carried thereby, against resistance of a spring 93. The noses of the lever 85 and slide 86 now move out of a square notch 68b of clutch disk 68, releasing the latter. At this moment, when the clutch disk is free to rotate, any reverse movement thereof is positively prevented by the coaction of pawl 88 with a ratchet notch 68c. Immediately upon the withdrawal of the nose of latch slide 86 from a square notch 68b, spring 87 pulls the slide down, thereby locating its nose below the square notch and opposite a peripheral arc of disk 68. This positively prevents the latch lever 85 and slide 86 from returning into the same square notch 68b, or returning into restraining coaction with disk 68 before the latter has made at least a quarter turn. After rotation of disk 68 and after deenergization of magnet 91, spring 92 returns shaft 82 and lever 81 with detent 80 clockwise, while spring 93 causes lever 85 and slide 86 to follow the lever 81. This occurs just before a square notch 68b of disk 68 reaches the now depressed nose of latch slide 86. As soon as the square notch reaches the nose of slide 86, the nose enters the notch and the continued rotation of disk 68 raises slide 86 against resistance of spring 87—which incidentally dampens the further travel of disk 68—until the square notch reaches the nose of latch lever 85. The nose of lever 85 thereupon springs into this notch, positively arresting rotation of clutch disk 68 at a predetermined quarter point of its revolution.

When magnet 91 was energized, it caused withdrawal of detent 80 from a tooth 78a of cam disk 78 and also release of lever 85 and slide 86 from clutch disk 68. As disk 78 was released, it enabled clutch dog 75 to engage driving ratchet 76, thereby coupling the now released disk 68 to shaft 44. Assuming the main clutch 45—46—47—48 has been engaged to cause rotation of main clutch shaft 44, then when disk 68 is coupled to shaft 44 by energization of magnet 91, the shaft 44 drives disk 68 at the speed of shaft 44. Consequently, carrier 67 fixed to disk 68 is also rotating at the speed of shaft 44, and sun gears 66 are revolving about the axis of the latter shaft at the speed of pinion 65 on this shaft. Hence, there is no relative rotation between gears 66 and pinion 65, these gears and the latter pinion being, in effect, locked to each other. As gears 66 have no simple rotational movements, their connected pinions 69 also cannot rotate and are locked to meshing gear 70 of sleeve shaft 71, causing the latter gear and its shaft to rotate also at the speed of shaft 44. Gears 72 and 73 on shaft 71 are now rotating at the speed of shaft 44. This is the high speed rotation of gears 72 and 73 brought about by the coupling of high speed clutch 68—75—76—78 to shaft 44 due to energization of high speed clutch magnet 91. The ratio of gearing between shaft 44 and sleeve shaft 71, when gears 65, 66, 69, and 70 are acting as a simple train of gearing—during normal speed operation—is such as to drive sleeve shaft 71 at one-tenth the speed of shaft 44. During high speed operation, the shaft 44 and shaft 71 rotate at the same speed. Thus, at high speed operation, shaft 71 rotates at ten times its normal speed.

Gears 72 and 73 on shaft 71 drive elements of the control section including card feed means

which will be described later. During normal speed operation of these gears, the card is fed at a speed such that one column thereof traverses a given reference line during one-quarter turn of main clutch shaft 44. The period of such travel of a card column is equal to but not coincident with one cycle point of the card cycle indicated in Fig. 31. The card cycle may be considered as the interval between arrival at the reference line of similar points of successive cards. During eighty points of the card cycle, the eighty card columns of a card traverse analyzing means described subsequently. A gap of ten cycle points then occurs before the next card cycle begins on the next card. During high speed operations of gears 72 and 73, when both the main clutch and high speed clutch are in action, the card is fed at ten times normal speed so that each cycle point and traverse of a card column past a given reference line takes one-tenth the normal time. Hence, when the card is fed at high speed, ten cycle points occur for each quarter turn of shaft 44 while during normal card feed only one cycle point occurs for each quarter turn of this shaft.

Zoning cycle commutators.—Shaft 39 (Fig. 5) is driven continuously by the motor and carries six commutators HS—1 to 6 (also see Fig. 32) which may be referred to as the zoning cycle commutators. The speed of shaft 39 is four times that of main clutch shaft 44, so that one revolution of this shaft, as well as of its commutators HS—1 to 6, corresponds to a quarter turn of shaft 44, which in turn corresponds, during normal card feed, to one card cycle point, as explained before. During high speed card feed, ten card cycle points elapse during one revolution of shaft 39 and its commutators. The revolution of shaft 39 may be referred to as the zoning cycle (Fig. 32) which during normal card feed, is equivalent to one card cycle point.

Rotated by shaft 39 through one-to-two gearing 100 is a shaft 101 carrying a commutator 1C (see Figs. 1, 5, and 33) which times line space or carriage return operations.

Shaft 39 also carries a zoning cycle index wheel 110 to index the zoning cycle positions of shaft 39 and the element actuated thereby.

To the left end (Fig. 1) of shaft 39 is fixed a bevel gear 112 which meshes with bevel gears 113 and 114, respectively on downwardly inclined shafts 115 and 116 (see Fig. 10).

Drive for zoning unit.—Shaft 115 at its lower end has a bevel gear 117 meshed with a bevel gear 118 on a horizontal shaft 119 (see Figs. 1, 2, and 7). Shaft 119 is provided with a pin 120 seated in the bayonet slot 121 of a sleeve coupling 122 mounted on the shaft. In line with shaft 119 is a shaft 123 which has a transverse, coupling pin 123a (Fig. 7) slidable into the open, end slots 122a of coupling 122. A spring 124 urges coupling 122 towards the left (Figs. 2 and 7) for maintaining the rear end of the horizontal portion of the bayonet slot 121 in engagement with pin 120. In this position, as indicated in Fig. 7, the slots 122a of the coupling sleeve 122 are receiving the pin 123a, thereby coupling shafts 119 and 123 for common rotation. To uncouple shaft 123 from shaft 119, coupling sleeve 122 is forced rearwardly until pin 121 is at the vertical portion of the bayonet slot, withdrawing slots 122a from pin 123a, and then the coupling sleeve is rotated to engage the pin 120 in the vertical portion of the bayonet slot, thereby maintaining the coupling sleeve in rear, release position.

With sleeve 122 in normal, coupling position, the shaft 39 drives shaft 123 one-to-one to make one revolution each zoning cycle. Shaft 123 is the actuating shaft of the zoning or code-translating system to be described later.

Inclined shaft 116 (Figs. 1 and 10) continuously rotated by gearing from motor-driven shaft 39, as previously described, drives the typewriter platen feed control or line space control or program unit which will be described later.

The main parts of the actuating mechanism have now been explained. The units of the machine driven thereby; the control section, the code translating or zoning unit, and the paper feed or line space program unit will be explained in order.

The control section (card handling section)

Referring to Figs. 1, 2, and 5, gears 72 and 73 of the clutch-driven (high or normal speed) shaft 71, operate the card reading or handling unit or control section. Gear meshes with and drives a gear 128 fixed to a cross shaft 129 on which are mounted eight commutators, CF—1 to 8 (only four are shown), which may be referred to as the card feed commutators. Shaft 129, and the parts mounted thereon and including commutators CF—1 to 8, make one revolution for each card cycle. As shown in Fig. 5, a disk 130 is attached to gear 128. This disk 130 is suitably graduated to indicate the card cycle, and may be referred to as the card cycle indicator.

Card picker means.—Referring to Fig. 2, shaft 129 carries complementary cams 131 for engaging rollers 132 and 132' provided on opposite arms of a lever 133. Lever 133 is connected by a link 134 to a picker slide 135 provided at the rear with a picker knife 135' for engaging the rear edge of the bottom card T of the stack of cards in supply magazine 136. The cards are stacked in magazine 136 in the predetermined order in which their data are to be listed, and the cards lie lengthwise in the magazine, with the columns extending crosswise. During each card cycle or revolution of shaft 129, its cams 131, acting through lever 133, link 134, and slide 135, reciprocate the picker knife 135' to feed the bottom card out of the magazine 136 and into the grip of upper and lower feed rollers 137 and 138. Since shaft 129 makes one revolution each card cycle, one card is fed to feed rollers 137 and 138 each card cycle.

The front and bottom frame 136' of card magazine 136, which also mounts the upper feed roller 137 (see Fig. 4), is capable of swinging upwardly about hinge studs 139 (see Fig. 21) to expose the parts underneath. The frame 136' is normally clamped down against the main frame by thumb screws 140 which may be turned to release the frame 136' and then swung away from the latter frame. When so released, frame 136' may be swung upwardly about hinge studs 139, the picker slide 135 sliding forwardly along its ways without interfering with the swinging of frame 136'. Below the base of frame 136' is located a pair of spring contacts 141 (Fig. 21) held closed, when frame 136' is in down position, by a pin 142 depending from the latter frame. When the frame is raised, pin 142 permits contacts 141 to open. Contacts 141 may be referred to as the supply magazine contacts, and, as will be brought out in the description of the circuits, open to prevent machine operation when the magazine frame 136' is in elevated position.

Card cycle program means.—One end of card cycle shaft 129 fixedly carries a driver 143 (see

Figs. 1, 12, and 13) having a pair of spaced studs 143a and 143b to fit into holes in the side of a card cycle program drum 144. The studs are of different sizes and their receiving holes are of corresponding sizes, so as to permit the drum to be placed on the driver in predetermined relation thereto. The hub of driver 143 is hollow to rotatably and slidably receive the shank of a hand knob 145, urged inwardly, towards the side of drum 144 by a coil spring 146 inside the hub of the driver. Hand knob 145 is provided with a clamping block 145' rectangular in shape, adapted to move through a similarly shaped hole 144' in the program drum. By turning the knob 145 to align block 145' with hole 144', the drum 144 is left free to be removed from driver 143. By turning the knob to bring its plate 145' at right angles to hole 144' (as indicated in Fig. 13) the knob block 145', under the influence of spring 146, firmly clamps the drum to driver 143.

In above manner, card cycle program drum 144 is rigidly but removably coupled to shaft 129 for one revolution each card cycle.

Drum 144 is constructed similarly to a spool with side flanges 144a. Each flange is similarly provided with ninety, equally spaced, radial slots 144b. There are ninety points in a card cycle (see Fig. 31), so that each of the ninety slots 144b corresponds to a definite point of the card cycle. The slots are numbered to indicate the points of the cycle to which they correspond. Each of flanges 144a is formed below the notches 144b with an inwardly extending annular bead 144c. Each of the notches 144b is designed to insertibly receive a spring clip 147. Each clip is generally U-shaped with the legs 147a bent in the form of angles, with the intermediate portions 147b projecting outwardly beyond the legs, and with the cross piece or head 147c connecting the spaced intermediate portions and legs. To place a clip on the drum flanges 144a, the legs of the clip are pinched together to enable them to be inserted between the flanges with the apexes of the leg angles located below beads 144c. As the clip is inserted, the intermediate portion 147b moves into the selected aligned slots 144b of the two flanges, with the head 147c extending across the flanges and between the aligned slots. The legs of the clip, after insertion, tend to spread, thereby gripping the insides of the flanges, while the beads 144c engage the leg angles to prevent radially outward movement of the clip. Since the intermediate portion 147b of the clip is seated in the aligned slots 144b, the clip is held against circumferential movement. Thus, clips 147 may be inserted on the drum 144 at desired points corresponding to points of the card cycle. The clips 147 may differ in the contour and effective width of their heads, some of the heads being of single width, others of double, still others of triple width, and some having a divided contour. The reason for the heads being of different widths and contours will be brought out hereinafter.

Adjacent drum 144 is a sub-frame 148 mounting a pivot 149 for a cam block 150 (see Figs. 12, 13, and 14) of insulating material and formed with an inclined cam lug 150a at the front and having its upper end provided with a V-notch 150b to seat the curved, hook end of a lower spring contact blade 151 underlying an upper contact blade 152, between them carrying the cooperating points of a switch 153. In the normal position of the parts shown in Figs. 13 and 14, lower blade 151 is in lowermost position and switch 153 is open. Drum 144 rotates counter-

clockwise (Fig. 13) and when the head of a clip 147 thereon rides past lug 150' of block 150, it cams against the lug to rock the block 150 momentarily to the rear. During this action of block 150, one of the sides of its V-notch 150b cams the lower blade 151 upwardly to close switch 153. As soon as the clip 147 passes the lug 150a, the parts of switch 153 return to normal and the switch opens. The points of the card cycle at which switch 153 is to be operated are determined by the setting on drum 144 of clips 147 having heads shaped to engage lug 150a during rotation of the drum.

Switch 153 comprises the card cycle program contacts for controlling tabular operation each card cycle to occur at predetermined points of the cycle, and may be referred to as the TAB program contacts. Means are provided, however, to suppress control by switch 153 during those card cycles in which heading cards are acted on. The control and suppression of control by switch 153 will be explained hereinafter in connection with the circuits and time charts.

Above pivot 149, sub-frame 148 mounts a shaft 154 on which is rotatably carried a square sleeve 155 of insulating material, one end of which is integral with a pinion 155a having eight teeth (see Figs. 12 and 16). A spring latch 156 engages between teeth of pinion 155a to hold the sleeve 155 impositively in the position to which it has been rotated. Straddling the periphery of sleeve 155 are spring contact blades 158 and 159 carrying, between them, the contacts 160. When blades 158 and 159 are engaging the flats of sleeve 155 (as in Fig. 13), they are closest to each other and contacts 160 are closed. When the sleeve 155 is given an eighth turn, it takes a diagonal position with respect to blades 158 and 159, spreading them apart to open contacts 160. When the head of a clip 147 rides past pinion 155a, it imparts an eighth turn to sleeve 155, moving the latter, if initially in diagonal position, to flat position with respect to blades 158 and 159, and to diagonal position if initially in flat position. When the sleeve 155 is turned to either diagonal or flat position, it is retained therein by latch blade 156 until the next clip 147 imparts another eighth turn thereto. Contacts 160 may be referred to as the high speed, program contacts since they control operation of the high speed clutch, in a manner which will be made clear later. The cycle point during which the contacts 160 are closed is determined by the setting of the clip 147 the head of which acts on pinion 155a to turn sleeve 155.

Below sleeve 155, bracket 148 mounts a spindle 162 (Fig. 13) rotatably carrying another square sleeve 163 of insulating material and provided at one end with a pinion 163a similar to pinion 155a and in substantially the same vertical plane as the latter. Sleeve 163 is straddled by spring contact blades 165 and 166 carrying contacts 167 between them. An eighth turn of sleeve 163 changes the condition of contacts 167, in the manner explained with respect to contacts 160. Pinion 164 is spaced from pinion 156 an arcuate distance spanning five teeth of drum 144, or the equivalent of five cycle points. Drum 144 rotates counterclockwise (Fig. 13) and the same clip 147 first rides past pinion 163a and five cycle points later rides past pinion 155a. Contacts 167 are the program, high speed initiating contacts, and combine with contacts 160 to control high speed clutch operation, as will be more fully described hereinafter. Preliminarily to a high

speed clutch action being effected, both contacts 167 and 160 are open. During a predetermined cycle point, depending on the setting of a clip 147, the latter will ride past pinion 163a and close contacts 167 to prepare the high speed clutch for operation, and five cycle points later the same clip will ride past pinion 155a to close contacts 160 for bringing the high speed clutch fully into operation.

At the side of sleeve 155, shaft 154 rotatably carries a pinion 168 of insulating material, similar to pinion 155a. The forward, hook end of a spring blade 170 is seated between the teeth of pinion 168 and is below a companion blade 171, the blades carrying contacts 172 between them. When a head of clip 147 rides past pinion 168, it imparts an eighth turn thereto, rotating it a distance between successive teeth. As pinion 168 rotates, a tooth thereof traverses and lifts blade 170 for closing contacts 172 momentarily. Contacts 172 are the zero elimination contacts, which, in a manner to be explained later in connection with the circuits, eliminate the reading out and printing of zero designations from columns of a numerical card field preceding the column bearing the first significant digit 1 to 9.

The clips 147 may have a single width head, offset to one side, for operating cam block 150 of TAB control contacts 153 alone. The same type of clip may be reversed end to end and inserted with its head closer to the outer facing flange, so as to operate pinion 168 alone, for closing zero elimination contacts 172 momentarily. A second type of clip 147 is provided, with a single width head intermediately located so as to operate in succession only pinions 163a and 155a, respectively, of high speed contacts 167 and 160. A third type of clip may have a wide head located to one side, for simultaneously operating pinions 155a and 168. The same clip, if reversed in position will be adapted to operate pinion 155a and block 150 at the same time. A fourth type of clip may have a divided head for jointly operating block 150 and pinion 168. A fifth type of clip may have a continuous, wide head, for simultaneously operating block 150 and pinions 155a and 168. Thus, all or any combination of the program contacts may be operated at the same cycle point to bring into action the several operations controlled by these contacts.

Card feed rolls and analyzer.—Gear 72 of the clutch-driven shaft 71 meshes with a gear 175 on the shaft of lower card feed roller 138 (see Figs. 1, 2, and 4). The shaft of the lower roller has a gear 176 meshed with a gear 177 on the shaft of upper feed roller 137, so that the upper and lower feed rollers rotate in unison. As previously described, picker blade 135' feeds a card T out of supply magazine 136 and into the grip of feed rollers 137 and 138 each card cycle. The feed rollers continue the feed of the card moving it at the rate of one column each cycle point.

Between the mouth or exit of the supply magazine and feed rollers 137 and 138 is arranged a card lever 178 (Fig. 2) which is engaged and cammed down by the card traveling to the feed rollers, for closing card lever contacts 179 during travel of the card.

Upper feed roller 137 is a conductive roller acting as the common of the card analyzing means. Coacting with roller 137 are twelve sensing brushes SB—9 to 0, 11, 12, to respectively sense index positions 9 to 0, 11 and 12 of a card column, while another brush SB—c acts as a common return brush, being located to the side of the card

and in constant engagement with roller 137 (see Fig. 4). Lower feed roller 138 is grooved so as to hold the free ends of the brushes in predetermined transverse spacing, and enable the brushes to extend substantially in tangential engagement with the lowest part of the feed and contact roller 137 in order to sense the card.

The above described card analyzing means, SB—137, analyzes the perforations of the card columns in succession, one column after another, to control the decoding, interpreting, or zoning system to be described later.

Card stacker.—As a card is fed by the rollers 137 and 138 past the analyzing means, it moves underneath a flexible plate 180, supported at the rear end, underneath a weighted plate 181 pivoted at its rear end, and into delivery magazine 182. Both plates 180 and 181 are cut out to permit a soft rubber arm 183 to rotate through and past the plates, so as to wipe the card and complete its ejection into the delivery magazine. Arm 183 is carried by a shaft 184 on which is a gear 185, driven through gears 186, 187, and 188 from gear 175 on the lower feed roll shaft. The gear ratio is such that arm 183 makes one revolution each card cycle to complete the ejection of the card analyzed during this cycle.

The stack of ejected cards in delivery magazine 182 rests on a bottom plate 190 hinged at its front end on a pivot 191. To the bottom of plate 190 is fast a bracket 192, passing through a slot 193 in the side wall of the magazine and rigidly provided outside the latter wall with a rack sector 194. Sector 194 meshes with a gear 195 (see Figs. 2 and 3) coaxing with a horizontal rack 196 provided on a sleeve 197 which slides inside a fixed tube 198. The rack 196 passes through a narrow slot in tube 198, preventing rotation of the sleeve 197. Between tube 198 and sleeve 197 is a coil spring 199 tending to move the sleeve to the left (Fig. 3). With no cards on plate 190, spring 199 is holding sleeve 197 at its left hand limit. As the cards stack up on plate 190, their weight depresses rack sector 194 which, through gear 195 and rack 196, causes sleeve 197 to move to the right, against resistance of spring 199. When the delivery magazine is full, the weight of the stack has moved bottom plate 190 downwardly to an extent sufficient to engage the lower edge of bracket 192 with an insulating tab 200 fixed to the lower blade 201 of a switch 203, thereby opening such switch to interrupt operation of the card feed unit, in a manner which will be explained later.

As described above, the cards are fed one at a time and column by column past analyzing means SB—137. The analyzing means senses the perforations in each column to control operation of a coding, translating, or zoning unit, which will now be described.

ZONING UNIT

The zoning unit includes twelve horizontal, parallel combination or comb bars 210, disposed one above another, and located at a distance below the typewriter keyboard, as indicated in Figs. 6, 24, and 27. Each comb bar corresponds to an index position of a card column and may be distinguished by referring to it as the comb bar of the correspondingly termed index position. Thus, bars 210—9, 8 . . . 1, 0, 11, 12 correspond to index positions 9, 8 . . . 1, 0, 11, 12 and their positions are indicated in Fig. 27.

Each of the comb bars 210 is formed with front lugs 210a arranged for combination with lugs 211

of the other combs in governing interpretation of a perforated designation code. Each comb also has a single rear lug 210b, and the lugs 210b of the several combs are staggered horizontally to enable each lug to be engaged by the free end of one of the twelve staggered armature levers 211, as indicated in Figs. 6 and 8. Each armature lever 211 is operated by one of the twelve zone magnets 212, arranged in two horizontal layers and staggered to enable the armature levers to dispose their free ends in engagement with the staggered lugs 210b of the several combs 210. A pair of opposite, end guide combs 213 and a central guide comb 214 (Fig. 7) guide the combs 210 for horizontally slidable movement. A spring 215 connected to each comb 210, urges the latter towards the left to a normal position, determined by engagement of a screw 216 (Figs. 6 and 8) carried by the armature 211 with the frame plate 217.

Upon energization of a zone magnet 212, it rocks its armature lever 211 counterclockwise (Fig. 8), causing the armature lever, by engagement with the associated lug 210b, to shift the corresponding comb bar 210 to the right.

Extending in front of the combs 210 are a plurality of spaced vertical levers 218 urged towards the combs by springs 219. The lower tip of each lever follows a cam 220 extending across all the levers and fixed to shaft 123. As previously explained under the heading "Drive mechanism," shaft 123 is continuously rotated, through a coupling 122, from motor-driven continuously rotating shaft 119. Shaft 123 makes one revolution each zoning cycle (Fig. 32), and during normal card feed, one zoning cycle corresponds to a card cycle point. Once each zoning cycle, cam 220 releases levers 218 for forward movement by springs 219. During each zoning cycle occurring between "1" and "80" of the card cycle during normal card feed, a column code analyzing period is provided during which analyzing means SB—137 is effective to analyze one card column for a designation or code. In accordance with the analysis, selected combs 210 are shifted to the right, to displace their front comb lugs 210a from in front of the lever 218 corresponding to the character or function represented by the analyzed perforated code in the active card column. There will be no other lugs 210a in front of the latter lever 218 but one or more lugs remain in front of the rest of the levers 218. Accordingly, when cam 220 releases levers 218 for inward movement, only one of these levers is enabled to move inwardly to a sufficient extent to bring the shoulder 218a of the lever above a common lift bail 221. Bail 221 extends across all the levers 218 and is provided with rollers 222 at each side following cams 223 fixed to zoning cycle shaft 123. Thus, for each cycle point or analysis of one card column, bail 221 is given one reciprocation. During the rise of the bail, by engagement with the shoulder 218a of that vertical lever 218 which has been released by the combs 210, the bail lifts the lever.

The upper end of each lever 218 is pivotally connected to a lever 224 urged counterclockwise (Figs. 6 and 27) by a spring 225 and pivoted to a link 226. Each link 226 is provided at its upper end with a stud 226a freely passing through a vertically elongated slot 227 in an associated one of the horizontal, operating levers 10 of the transcribing unit. To yieldably and releasably maintain the side of link 226 firmly against the

side of the associated lever 10 and prevent accidental withdrawal of stud 226a, a flat spring 228 is fixed to the side of each link 227, the spring and link engaging the associated lever 10 between them.

When the lever 218, which has been selected by combs 210, is lifted by bail 221, it rocks lever 224 clockwise (Fig. 6) against resistance of spring 225, thereby lowering link 226 to depress the corresponding operating lever 10. Depression of the lever 10 effects the recording or other function of the transcribing unit, as denoted by the code in the analyzed card column.

As indicated in Fig. 9, the combs 210 have front lugs 210sp. The lugs 210sp of the twelve combs are in vertical alinement and located directly to the left (Figs. 7 and 8) of the vertical lever 218sp. No matter which code combination is sensed on a card T, at least one of the combs 210 will be moved to the right, thereby placing its lug 210sp in front of lever 218sp to prevent its coaction with the lift bail 221. Lever 218sp is operatively connected with the intraline space operating lever 10—SP. Thus, when any code is sensed and interpreted, causing actuation of one or more of the combs 210, lever 218sp will be blocked against operation, permitting the intraline spacing of the carriage 24 (see Fig. 6) to occur only as the usual incident to the operation of the lever 10 corresponding to the character whose designation has been found in the analyzed card column.

When the card column traversing the analyzing means is blank, then an operation of intraline space lever 10—SP is indicated. Thus, failure to sense any perforation in a card column leaves all the combs 210 in their normal positions, with all the lugs 210sp out of the path of lever 218sp which thereby is enabled to move forward to cooperate with lift bail 221 for operating space lever 10—SP to effect an intraline spacing of the carriage 24.

During certain operations; namely, tabulating under control of the program drum 144, high speed clutch operation, carriage return or line space operation, for the period of each cycle between the departure of one card from the analyzing means and the arrival of the next card, and, whenever main clutch shaft 44 is at rest, none of the combs 210 is actuated. Accordingly, operation of intraline space lever 10—SP would be effected, undesirably, under control of operating lever 218sp each cycle of shaft 123, unless provision were made to the contrary. To lock out the operating lever 218sp under the above conditions, a space lock magnet 230 (Figs. 8 and 27) is provided, energization of which rocks its armature 231 downwardly to rock a lever 232 clockwise (Fig. 27) against resistance of a spring similar to spring 225. Pivottally suspended from lever 232 is a lock arm 233 urged towards the right (Fig. 27) by a spring similar to spring 219. The lower end of arm 233 is formed with a bent lug 233a, from an intermediate portion of which a tab 233b projects parallel to the side of arm 233. The inward movement of arm 233 is limited by engagement of tab 233b thereof (see also Fig. 8) with the front of the bottom guide comb 234 of the operating levers 218. Thus, upon clockwise rocking of lever 232, effected by armature 231 upon energization of magnet 230, lock arm 233 will be moved vertically upward. The outer, reduced end of lug 233a of arm 233 overlaps operating lever 218sp and normally lies against the back of the lever, entirely below and out of a

notch 218'sp formed on the space operating lever (see Fig. 27). When lock arm 233 is lifted as a result of energization of magnet 230, lug 233 moves upwardly into notch 218'sp, thereby locking lever 218sp against inward movement. Thus, even though none of combs 210 is actuated, if magnet 230 is energized, it will cause locking of the space bar operating lever 218sp.

To time the impulses to space lock magnet 230 for each column or cycle point, a switch 235 is provided which is closed by lift bail 221 when the bail is in lower position and which opens when bail 221 rises. Since bail 221 is given one reciprocation each cycle point, switch 235 will open and close once for each cycle point. It is to be understood, however, that switch 235 does not, of itself, close the circuit of magnet 230. The latter circuit will be traced hereinafter.

The number 1 and the letter l are printed by the same type lug on the "L" type bar 18. The code for number 1 is a "1" perforation while the code for letter l is X—3 (see Fig. 30). Thus, when either of these codes is sensed, the same type bar 18 must be operated. To accomplish this, the intermediate, horizontal lever 224—L of the "L" operating lever 218—L is rigidly connected by bridge pieces 236 to the intermediate, horizontal lever 224—1 of the "1" (numerical code) operating lever 218—1 (see Figs. 7 and 8). Only the lever 224 of the L linkage is connected by a link 226 to the "L" lever 10. The lever 224 of the numerical "1" linkage is not connected to any link 226. Accordingly, when an "L" code is analyzed, the "L" lever 218 will act through the connected lever 224 and link 226 to operate the "L" lever 10. When the "1" code is analyzed, the "1" lever 218, acting through its associated lever 224 and bridge pieces 236 will rock the "L" lever 224 to effect operation of the "L" lever 10, just as when an "L" code is analyzed.

All the letters are preferably typed in upper case, as capitals, and all the numerals are typed in lower case. As may be understood from the showing of the codes in Fig. 30, all the alphabet codes A to Z are combinational codes which include, in addition to an intrazone characteristic 1 to 9, at least one of the zone characteristics, 0, X, or R, while the numerical codes 1 to 9 are single hole codes distinguished by absence of a zone characteristic. The digit 0 (zero) is represented by a single perforation in the 0 position. As will be explained later in detail in connection with the circuits, whenever zone and intrazone perforations occur together in a card column, denoting a letter of the alphabet, the analysis of these two perforations causes energization of a double coil shift magnet 240 (see Figs. 8 and 24). When only a single perforation, intrazone or zone, is analyzed in a card column, then the shift magnet remains deenergized. Thus, the numerical codes will be interpreted by lower case type bar operations while the alphabet codes will be interpreted by upper case type bar operations.

Energization of magnet 240 rocks its armature 241 downwardly, and the armature acts through a link 242 to depress the right hand shift lever 10—SH, thereby effecting an upper case shift. This shift is timed to occur just before the operation of the lever 10 corresponding to the alphabetic code in the analyzed column, as will be further explained hereinafter.

Thus, the combinational alphabetic code not only controls the printing of the letter represented thereby, but also the upper case shifting oper-

ation which accompanies the typing of the latter.

A "12" perforation occurring alone in a card column indicates a carriage return operation, and analysis of this perforation energizes the magnet 212 of comb 210—12. This same magnet may also be energized independently of a code perforation to cause a carriage return operation to occur, as will be explained later in connection with the circuits. When comb 210—12 alone is operated, the carriage return lever 218CR (Figs. 7, 8, 24, and 25) is released for coaction with lift bail 221. As lever 218CR is lifted by bail 221, it rocks the connected lever 224 counterclockwise (Fig. 24). Fastened to the latter lever 224 is a member 245 carrying an insulating pin 246 which, upon rocking of this lever, closes a switch 247, the purpose of which will be explained hereinafter.

Due to the operation of lever 218CR, the carriage return operating lever 10—CR (Figs. 1 and 7) is depressed to effect a carriage return operation of the carriage 24 (Figs. 1 and 6), and as an incident to the carriage return, a line spacing operation occurs, as usual.

Towards the latter part of the revolution of shaft 123 of the zoning system, a cam 250 thereof (Figs. 7, 8, and 24) effects clockwise rocking (Fig. 24) of a lever 251. The upper end of lever 251 bears against the arm 252a of a knock-off bail 252 (also see Fig. 26), which has an arm 252b extending vertically across the right hand edges of all the combination combs 210. Upon clockwise rocking of lever 251 by cam 250, the upper end of the lever rocks bail 252 clockwise (Fig. 26), causing arm 252b thereof positively to engage and return all the combs 210 to the left. Thus, the combs 210 and the armatures 211 are positively restored at a definite, latter portion of the cycle of shaft 223, after which the springs 215 connected to the combs yieldingly maintain the combs in their restored positions.

The mechanical features of the zoning system have been explained above. Further explanation of its operation will be given as an incident to the description of the circuits hereinafter.

LINE SPACE CONTROL UNIT

As previously described, the motor driven shaft 39, making one revolution each zoning cycle (Fig. 32), effects rotation in one-to-one ratio, of the inclined shaft 116 of the line space control unit. Referring to Figs. 1 and 10, the lower end of shaft 116 carries a bevel gear 260 meshed with a bevel gear 261. Gear 261 is fast to a sleeve shaft 262 rotatably surrounding a shaft 263. Between shafts 262 and 263 is provided a line space clutch similar to the main clutch, previously described. The line space control clutch comprises a ratchet 264 fast to sleeve shaft 262 for engaging a clutch pawl 265 carried by a plate 266 fast to shaft 263. A loosely mounted cam disk 267 between the plate 266 and the side of pawl 265 holds the latter disengaged from ratchet 264 as long as a tooth of the cam disk is latched up by the nose of a latch lever 268. The lower end of the latch lever coacts with the armature lever 269 of the double coil clutch magnet 270.

Energization of magnet 270 releases cam disk 267, causing pawl 265 to engage ratchet 264, thus coupling shaft 263 to the ratchet. On shaft 263 is a worm 272 acting through worm wheel 273 to drive a shaft 274. Shaft 274 rigidly carries a driver 275 on which a line space program drum 276 is removably but rigidly mounted for rotation thereby, in the same manner as explained in

connection with the card cycle program drum 144. Drum 276 is narrower but otherwise similar to drum 144 and also has ninety notches 276a in its periphery to insertibly receive and hold spring clips 277, similar to clips 147.

Each energization of magnet 270 brings the paper feed clutch 264—265—266—267 into action to advance drum 276 counterclockwise through one step, equal to one-ninetieth of its revolution. The energization of magnet 270 is effected upon closure of contacts 247 (Figs. 8 and 25) which, as previously described, occurs upon each carriage return (and line space) operation. Thus, for each carriage return or line space operation, program drum 276 is moved one step or the distance between successive notches 276a. Drum 276 may, therefore, be referred to as the line space program drum. Since there are ninety notches on drum 276, the latter may control a maximum of ninety line spaces of a single bill form. The bill forms to be used for one stack of cards are of the same length and, if desired, may be separated by a perforated tearing line.

Each bill form is intended to bear heading data such as the name and address of the consignee, and other information, which may be referred to as constant data. After the heading is typed, a series of lines are skipped, and then the so-called item, detail, or variable data is recorded. This variable data is in the form of lists, and may consist of names of items, their code number, quantity, their unit prices, and total price for the quantity. After this data is typed in, a series of lines are skipped and the total price of all the billed items typed in. Following this total printing, a series of lines are skipped to the first line of the heading field of the next bill form.

A typical series of such successive bills is indicated below, supplemented by numbering (which need not actually be present on the bills) of the lines. Each bill will be seen to occupy thirty lines, and three bills occupy ninety lines, so that the ninety notches of line space program drum 276 may be set for a series of three such successive bills.

0				
1	Truck 4			
2				
3	March 15 1937			
4				
5	Norton Hardware Co			
6	7105 Madison Ave			
7	Scranton Pa			
8				
9				
10				
11				
12				
13	1482 24 Ornamental hinges	06	144	
14	1625 6 Wrought steel hinges	05	180	
15	1815 24 Night latches	12	288	
16	3102 12 Brass chest locks	46	550	
17	3425 12 Padlocks	17	204	
18	3210 24 Sash locks	46	240	
19	3480 24 Awning pulleys	03	72	
20				
21				
22				
23				
24				
25				
26	Total			4602

27
28
29
30
31 FRTDLWR R
32
33 March 15 1937
34
35 Consumers Elec Co
36 Batavia Stores
37 Batavia N Y
38
39
40
41
42
43 5643 3 Single bit axes 110 330
44 5648 3 Double bit axes 140 420
45 5700 12 8 16 auger bits 12 144
46 5705 12 12 16 auger bits 21 252
47 5712 12 16 16 auger bits 46 444
48 6101 48 H S hack saw blades 04 192
49 6109 36 24tooth hacksaw blades 05 180
50
51
52
53
54
55
56 Total 1678
57
58
59
60
61 Truck 4
62
63 March 15 1937
64
65 Norton Hardware Co
66 7105 Madison Ave
67 Scranton Pa
68
69
70
71
72
73 1482 24 Ornamental hinges 06 144
74 1625 6 Wrought steel hinges 05 280
75 1815 24 Night latches 12 288
76 3102 12 Brass chest locks 46 550
77 3425 12 Padlocks 17 204
78 3210 24 Sash locks 46 240
79 3480 24 Awning pulleys 03 72
80
81
82
83
84
85
86 Total 4602
87
88
89

The variable items of the bills are in listed form, which requires tabular spacing operation of the recording unit. The tabular spacing may be effected either under control of the tabular code "11" in a card column or under control of the card cycle program drum 144. When the program drum 144 is used to control the tabular

spacing, then, since this drum makes one revolution each card cycle, its control will be repeated for each detail card T of the stack passing through the machine. Thus, the variable items derived from individual, successive detail cards T will be typed in the form of columns or lists. The heading or other constant data of a bill or statement, and the total are not to be listed as are the variable data, and when the record card or cards bearing the heading and total data are passing through the machine, the tabular spacing control, as well as the high speed clutch control, both exercised by drum 144, are suppressed. This suppression is effected under control of clips 277 placed in slots 276a of line space program drum 276. Each of the bills printed under control of the same stack of cards is of the same length, and has the same heading field, variable item field, and total field allocated thereto. Each such field corresponds in length to a known number of lines, and since program drum 276 is moved in synchronism or in step with the line spacing of the bill forms, then for each line of the latter, the latter program drum will be in a definite and predetermined position. Further, since each recorded line of a form is typed under control of a record card set in predetermined order in card magazine 136, the program drum 276 will be in predetermined position for each record card associated with a bill. Thus, when the heading card or cards is passing through the machine, the program drum 276 will have definitely numbered notches 276a thereof passing a reference position. Since tabular spacing and high speed operation as controlled by card cycle program drum 144, are to be suppressed for the heading card or cards, clips 277 may be set in the predetermined notches 276a so as to control suppression of these tabulating and high speed operations during the recording of any desired lines of the bills. These clips control such suppression through contact means which will be described presently and which may be referred to as the suppression contact means.

Program drum 276 controls not only suppression of tabulating and high speed operations for the heading data, but also the vertical, multiple line spacing between the heading data and the variable data, between the variable data and the total line, and between the total line and the heading data of the next bill form. For this purpose, clips 277 are set in the notches 276a so as to control repeated line spacing operations. The line spacing is effected by repeated depression of the carriage return lever 10—CR. Thus, the carriage return lever is not only operable under control of a "12" code in a card but also under control of program drum 276. The control of line spacing by drum 276 is effected through contact means which may be referred to as the line space control contact means. The line space contact means and the suppression contact means will now be described.

Referring to Figs. 1, 22, and 23, at one side of program drum 276 is a frame bracket 285 which rigidly carries a vertical shaft 286. Rotatably carried by shaft 286, above the boss 285' of bracket 285 is a sleeve 287 having a narrow lower pinion 288a and an upper wider pinion 288b, the sleeve and its pinions being of insulating material. Coacting with pinion 288a is the hooked end of a leaf spring latch 289 which serves to positively hold sleeve 287 in position. Coacting with pinion 288b is the bent end of spring blade 290, companion to which is a spring blade 291.

Between them blades 290 and 291 carry the points of the line space switch 292. Switch 292 is normally closed (see Fig. 23) but when the head of a clip 277 rides past pinion 288a, it imparts an eighth turn to sleeve 287, causing pinion 288b to momentarily open switch 292. The clip 277 is set in a slot 276a corresponding to the line of the bill form at which automatic, program line spacing is to terminate. The manner in which switch 292 controls automatic line spacing will be brought out in connection with the description of the circuits and timing.

Below boss 285' of bracket 285, shaft 286 rotatably carries a square sleeve 294 of insulating material (Fig. 22) formed with a pinion 294a at its upper end, and straddled by spring blades 295 and 295' (also see Fig. 23), carrying between them the points of a switch 296. This square sleeve and contact assembly is similar to the square sleeve 155 and the contact assembly associated therewith (see Fig. 13) of the tabular spacing control means associated with the card cycle program drum 144.

Switch 296 is the high speed and tabular spacing suppression switch, the control by which will be explained in the later description of the circuits and timing. When blades 295 and 295' are straddling the flats of sleeve 294, switch 296 is closed, and when straddling a diagonal of the sleeve, the switch is open. Sleeve 294 is moved from the flat to the diagonal position or the reverse by a clip 277 on drum 276 as the head of the clip rides past the pinion 294a and effects an eighth turn of the latter. The sleeve 294 and the parts associated therewith are impositively held in actuated position by a latch spring 297 engaged with the teeth of pinion 294.

In addition to the suppression and line space switches associated with the program drum 276, a home position switch 298 (Figs. 1 and 10) is provided. This switch is normally closed, but opened when the program drum reaches 0 line, home, or start position. For opening switch 298, a cam arm 299 is adjustably but rigidly secured to the bottom of driver 275 of drum 276. When the drum reaches home position, arm 299 engages the longer blade of switch 298 to open the latter. The purpose of home position switch 298 will be brought out later.

The operation of the parts will now be brought out in connection with the following description of the circuits and timing diagrams:

CIRCUITS, TIMING, AND OPERATION

Referring to Fig. 34c, with main line switch SW closed, motor 35 is set in operation, the circuit therefor going through card supply magazine contacts 141 (also see Fig. 21), so that the opening of these contacts by the raising of magazine frame 136' breaks the motor circuit. Only with frame 136' in operative position, do contacts 141 remain closed to enable the motor circuit to make and cause operation of motor 35.

In the following description, it is assumed the parts are initially in 0 cycle position of the card cycle (see Fig. 31).

Having brought the first line of a bill form to printing position on platen 20 of the recording unit, and having placed the stack of cards T bearing the data for the bills in supply magazine 136, to start operations, the start key is depressed to close start key contacts ST, forming the following circuit (bottom of Fig. 34a):

Start key circuit.—From the left side, through

contacts ST, normally closed relay contacts R—17b, relay coil R—7, to the right side.

In the following parts of the description, the term "high speed" may be abbreviated as "H. S."

A parallel circuit forms as follows:

Initial H. S. clutch circuit.—From the left side, through contacts ST, contacts R—17b, commutator CF—6 (initially made, see Fig. 31), normally closed relay contacts R—2a, H. S. clutch magnet 91 (also see Fig. 5), and to the right side.

Due to energization of coil R—7 by the start key circuit, relay contacts R—7b are closed to form the following main clutch circuit (middle of Fig. 34b):

Main clutch magnet circuit.—From the left side, through normally closed recorder unit contacts 28 (also see Fig. 28), normally closed relay contacts R—3b, now closed relay contacts R—7b, normally closed relay contacts R—22b, R—14c, relay contacts R—27b (now closed due to initial energization of a coil R—27, in a manner which will be explained later), normally closed relay contacts R—10b, main clutch magnet 53 (also see Fig. 5), and to the right side.

Now, with both main clutch magnet 53 and H. S. clutch magnet 91 energized, the control section or card reading unit operates at high speed, or ten times normal speed, as previously explained. Thus, shaft 71 is now acting through gears 72 and 73 to actuate the card feeding means at high speed. At the "0" cycle point, picker 135 (see Fig. 2) is in advanced position, ready to begin its return stroke (see Fig. 31). As the machine is now set in operation for the first card cycle at high speed, the picker is moved through its return stroke at high speed, and at the end of this stroke, at about the 64th cycle point, the picker is at the rear of the bottom card T in magazine 136 (see Fig. 2). The picker then dwells until about "70" of the card cycle at which point it begins its forward stroke to feed the bottom card to the feed rollers 137 and 138. Commutator CF—6 breaks at "69" of the card cycle, thereby opening the initial H. S. clutch circuit, and the normal card feed resumes at about "70." Thus, during the first card cycle, in order to same time, the picker 135 is moved at high speed to bring it into card feeding position, and then its speed is reduced to enable it to pick up the first card positively at normal speed.

The interruption of the initial high speed action is effected upon deenergization of H. S. clutch magnet 91 due to breaking of commutator CF—6 at the 69th cycle point (see Fig. 31). The deenergization of magnet 91 causes detent 80 (Fig. 18) and latches 85 and 86 to disengage the high speed driven clutch disk 68 at "80" of the "69" cycle point (Fig. 32) or shortly before the 70th cycle point. Now, with only the main clutch in action, the card feed means, including picker 135, continues operation at normal speed, and feeds the bottom card T out of magazine 136 and into the grip of coacting card feed rolls 137 and 138 (Figs. 2 and 4), which continue the feed of the card.

The perforation field or width of the first card column or column 1 of the card reaches the line of sensing brushes SB shortly before the "1" cycle point of the card cycle, between the 80th and 90th divisions of the "0" cycle point, as indicated by the upper, "card brush" timing line, in the zoning cycle chart, Fig. 32. The "card brush" line indicates the periods of sensing of perforations in successive card columns by brushes SB. Between "0" and "55" of one zoning cycle, the

greater and latter portion of a hole in one column is sensed and during this period, commutator HS—1 is made to render the sensing effective to perform an analysis, as will be further explained hereinafter. After this effective analyzing period of one card column during one zoning cycle, the brushes SB sense, between "85" and the end of the zoning cycle, the first part of the perforation of the next column, but with HS—1 broken, this latter sensing is not effective to perform an analysis.

During the first card cycle (Fig. 31) the picker started moving the first card out of magazine 136 and to feed rolls 137 and 138. During its travel to the feed rolls, the card engages card lever 178 and cams it down to close card lever contacts 179 (Fig. 2) after the beginning of the 82nd cycle point. Closure of contacts 179 establishes the following circuit (top of Fig. 34a):

Card lever circuit.—From the left side, through contacts 179, relay coils R—1 and R—2, to the right side.

Energization of coil R—2 opens relay contacts R—2a of the initial H. S. circuit, so as to prevent further high speed operation under control of commutator CF—6 unless, as will be explained further on, the high speed drive is called into action either by an H. S. eject code (see Fig. 30) or by high speed control of the card cycle program drum 144 (Figs. 1, 12, 13, and 14).

The operator need only hold the start key depressed until the first card is seen to enter the feed rolls 137 and 138, since by then card lever contacts 179 have closed, and the card lever circuit has been established to energize coils R—1 and R—2. Coil R—2 now has closed contacts R—2b (bottom of Fig. 34a), shunting start key contacts ST through the following shunt circuit:

Start key shunt circuit.—From the left side, through relay contacts R—2b, stop key contacts SK, stacker contacts 203 (opened when the stacker magazine 182, Fig. 2, is full), stick contacts R—7a (previously closed), relay coil R—7, and to the right side.

Coil R—7 now remains energized until either the cards are exhausted from supply magazine 136, causing the card lever contacts 179 to open and eventually deenergize coil R—2 with consequent opening of contacts R—2b, or upon depression, at will, of the stop key to open contacts SK, or when the stacker magazine 182 is full, causing contacts 203 to open.

There is a gap between successive cards feeding from magazine 136, and the lagging edge of the leading card will leave card lever 178 and permit card lever contacts 179 to open at "78" of the card cycle, while the forward edge of the following card will not cause contacts 179 to make again till after "82" of the same card cycle. To maintain coils R—1 and R—2 energized during this open interval of card lever contacts 179, commutator CF—4 makes (see Fig. 31), shunting contacts 179 through the following path (the top of Fig. 34a):

Card lever shunt.—From the left side, through commutator CF—4, stick contacts R—1a, coils R—1, R—2, to the right side.

If the stack of cards is exhausted, contacts 179 will not have been reclosed and when commutator CF—4 breaks at "84" of the card cycle, coils R—1 and R—2 will be deenergized. Contacts R—2b will open and the Start key shunt circuit will break to deenergize coil R—7. As a result, contacts R—7b will open to break the Main clutch magnet circuit. Main clutch magnet

53 remains energized, however, till the end of the card cycle through a shunt circuit formed through commutator CF—5 (see Fig. 31), which makes at "82" and opens at "89." The making of commutator CF—5 shunts contacts 28, R—3b, R—7b, R—22b, R—14c, R—27b, and R—10b of the Main clutch magnet circuit, as indicated in Fig. 34b, permitting clutch magnet 53 to remain in effect until the beginning of the 89th cycle point. The main clutch is uncoupled, as a result, at the 80th division (see Fig. 32) of the 89th cycle point.

The analyzing or card reading period of a card cycle is indicated by the top line of Fig. 31 and extends from "1" through "80," during which period, the Card read commutator CF—1 is made. The card lever circuit has energized coil R—1 to close contacts R—1b, forming the following circuit during the card reading period (Fig. 34a):

Coil R—9 circuit.—From the left side, through commutator CF—1, contacts R—1b, wire 310, coil R—9, to the right side.

Coil R—9 now closes the left side of transfer contacts R—9b (near the top, right of Fig. 34a) and opens the right side of these transfer contacts. This condition of the contacts R—9b endures through the card reading period under control of commutator CF—1 and is repeated every card cycle as long as cards continue to feed and through the card lever circuit maintain relay coil R—1 energized to hold contacts R—1b closed in the coil R—9 circuit.

All the alphabetic codes include in addition to an intrazone perforation or characteristic 9 to 1, one of the zone perforations or characteristics 12, 11 or 0 (see Fig. 30). Thus, analysis of an alphabetic code involves two analyzing circuits, one through a zone characterizing perforation and the other through an intrazone characterizing perforation in the same card column. Assume that a "12" zone letter is being analyzed, then the sensing of "12" perforation will form the following circuit (Fig. 34a):

"12" zone analysis.—From the left side, through commutator CF—1, contacts R—1b, zoning commutator HS—1 (see Fig. 32), normally closed relay contacts R—13b, clutch arm contacts 63 (see Fig. 19 for construction and Fig. 32 for timing), common brush SB—c, contact roll 137, brush SB—12, the left, now closed, side of transfer contacts R—9b, through the "12" comb magnet 212, a pickup coil 325 in parallel with magnet 212 and the purpose of which will be explained hereinafter, and through relay coils R—8 and R—4, to the right side.

As indicated by above analyzing circuit and by reference to the card cycle chart, Fig. 31, commutator CF—1 times the card reading period, so that after the 80th or last card column has passed brushes SB, the engagement of the brushes with the bare contact roll 137 will be ineffective to form any analyzing circuits.

Relay contacts R—13b common to all the analyzing circuits open during high speed control by program drum 144, in a manner to be explained later, to prevent analyzing circuits forming during high speed operation of the control section. When the main clutch is at rest at "80" of a zoning cycle (see Fig. 32), clutch arm contacts 63 are open (also see Fig. 19) to prevent formation of any of the analyzing circuits. The function of coils R—8 and R—4 in the "12" zone analysis circuit will be explained later. Comb magnet 212—12, upon energization, shifts its

associated comb bar 210—12 to the right (Fig. 8).

Since each alphabetic code in addition to the zone characteristic 12, 11, or 0 also has an intrazone perforation 9 to 1, the analysis of alphabetic code forms an intrazone analyzing circuit simultaneously with the zone analysis circuit. The intrazone analyzing circuit is as follows (Fig. 34a):

Intrazone analysis.—From the left side, through CF—1, R—1b, HS—1, R—13b, 63; brush SB—c, common roller 137, the active one of the brushes SB—1 to 9 sensing the intrazone perforation 1, 2 . . . 8, or 9, the comb magnet 212 in series with the active brush, the coil 325 in parallel with the comb magnet, and through common intrazone circuit relay coils R—5 and R—16 to the right side.

The intrazone analysis and the zone analysis result in a pair of comb magnets 212 moving associated combs 210 to the right (Figs. 7 and 8) in readiness to release the lever 218 corresponding to the alphabetic character denoted by the sensed zone and intrazone holes in the card column. The forward movement of this lever 218 does not occur until cam 220 (Figs. 6, 24, and 27) permits the levers to drop off the high point of the cam. This occurs shortly before "20" of the zoning cycle (Fig. 32). Before analysis of the column designation and resulting displacement of selected combs 210, the lever 218 corresponding to this designation is in front only of lugs 210a (Fig. 9) of these combs. The displacement of these combs removes their lugs from in front of the lever 218 corresponding to the analyzed designation, thus selecting this lever for operation. There is at least one lug 210a in front of every other lever 218. When cam 220 releases levers 218, they move forward to sense comb lugs 210a (see Fig. 9). All the levers 218 will be stopped by the comb lugs with the exception of the selected lever which corresponds to the analyzed character. This selected lever moves forwardly between lugs 210a of the combs, thereby locating its shoulder 218a above lift bail 221 (Figs. 24 and 27). At about "24" of the zoning cycle, circuit breaker HS—1, which times the duration of the analysis of a column perforation, opens and breaks the analyzing circuits to deenergize the comb magnets 212. Springs 215 (Figs. 7 and 8) now tend to return the previously actuated combs 210 but this is prevented at this time by engagement of sides of lugs 210a thereof with the selected lever 218 which has moved forwardly between these lugs.

At "50" of the zoning cycle, lift bail 221 rises and by engagement with shoulder 218a of the forwardly positioned, selected lever 218, lifts the latter to operate the associated lever 10 for causing a type bar 18 (see Fig. 6) to strike platen 20 at about "81" of the zoning cycle to record the character corresponding to the analyzed designation. At "90" of the zoning cycle, cam 220 has withdrawn the selected lever 218 from all the lugs 210a of combs 210, thus releasing the previously actuated combs for restoration by their springs 215. Shortly thereafter, at about "95" of the zoning cycle, cam 250 (Figs. 7 and 24) operates lever 251 to cause bail 252 to positively restore and align combs 210 in normal positions.

The above explanation indicates the operations and timing thereof occurring during a zoning cycle or cycle of the zoning or transcribing system and which corresponds, when the card is being fed at normal speed, to a card cycle point. These operations cause the transcribing means

under control of a designation in a card column to transcribe and record the corresponding character.

The intrazone analyzing circuit and the "12" analyzing circuit have been traced. The "11" analyzing circuit is as follows (Fig. 34a):

"11" zone analysis.—Beginning as in the previously traced analyzing circuits and proceeding from contact roll 137 through brush SB—11, the normally closed, right side of transfer contacts R—14b, comb magnet 112—11, magnet 325 in parallel therewith, and through relay coils R—20 and R—23 to the right side. The "0" analyzing circuit is as follows:

"0" zone analysis.—Beginning as in the previous analyzing circuits and proceeding from roll 137 through brush SB—0, normally closed zero elimination contacts R—25b, comb magnet 212—0, the magnet 325 in parallel therewith, and through coil R—24, to the right side.

As previously explained, the failure of any of the combs 210 to be actuated allows the lever 218sp to move forward for controlling an intraline space operation. Any comb 210 when actuated interposes a lug 210sp (Fig. 9) in the path of the lever 218sp, preventing effective operation thereof. The absence of any perforation in a card column allows all the combs 210 to remain in normal position and permit the intraline space lever 218sp (Figs. 7, 8, and 27), upon release by cam 220 at about "20" of the column cycle (Fig. 32), to move forward above lift bail 221. As a result, during the zoning cycle, lever 218sp is effective to operate lever 10—SP (Figs. 1 and 27) for effecting intraline spacing.

Case shift control.—The zone and intrazone analysis circuits select a lever 218 and thereby a type bar 18 for operation, according to the analyzed code in a card column. It is desired, in the present case, to print all the alphabetic characters or letters in upper or capital case and the numerals in lower or numeral case. As previously described, the upper case shift is effected by energization of magnet 240 (Figs. 8 and 24). The energization of magnet 240 is effected automatically in the present case without the use of a separate case shift code or card column to contain such code. To cause automatic case shift for all letter codes and to cause numeral case shift for numeral codes, the differentiation in codes between letters and numbers is utilized. Thus, all the letters are combinational codes (see Fig. 30) having in addition to the intrazone point 9, 8, 7 . . . 2, or 1, one zone point "12," "11," or "0," while the numeral codes have only an intrazone point 9 to 1 and zero (0) has only a "0" perforation. As will be brought out below, the analysis of a combination of zone and intrazone points in a card column causes energization of shift magnet 240 to precede the printing operation while analysis of only one point in a card column fails to energize the shift magnet. Thus, all the letters (combinational code) will be printed in upper case and all the numerals (single point code) will be printed in lower case.

As indicated by the tracing of the intrazone analysis circuit, the analysis of a perforation 1 to 9 results in energization of common relay coils R—5 and R—16. The "12" zone analysis energizes coils R—8 and R—4. The "11" zone analysis energizes coils R—20 and R—23. The "0" zone analysis energizes coil R—24.

R coils R—5, R—4, R—23, and R—24 control the circuit of shift magnet 240, which is as follows (lower part of Fig. 34a):

Shift magnet (coil R—6 and magnet 240) circuit.—From the left side, through lines 311, 312, then alternatively through either of the parallel relay contacts R—24a, R—23a, or R—4a, then through contacts R—5a, and, in parallel, through shift magnet 240 and a coil R—6, to the right side.

Thus, if the "12" zone analysis circuit is formed, coil R—4 will have closed contacts R—4a, but unless an intrazone circuit also has been formed and energized coil R—5 to close contacts R—5a, then the above shift magnet circuit will not form. Similarly, if in addition to closure of contacts R—5a, the "11" analyzing circuit has closed contacts R—23a or the "0" analysis has closed contacts R—24a, the shift magnet will be energized. If only an intrazone circuit has formed to close contacts R—5a and none of the zone analysis circuits have formed to close one of the contacts R—4a, R—23a, or R—24a, the shift magnet circuit will not form. Also, if either the "12," "11," or "0" analysis alone has been made, then contacts R—5a will be open, preventing energization of shift magnet 240. Thus, only for a combination code, designating a letter, is shift magnet 240 energized to effect upper case shift.

The analyzing circuits are timed by commutator HS—1 (Fig. 32) to make between "0" and about "24" of the zoning cycle and, consequently, the shift magnet circuit also forms before "25" of the zoning cycle. The type strikes the platen after "80" of the zoning cycle (Fig. 32) so that the type basket 19 (Fig. 6) is in upper case position before printing is effected.

The analyzing circuits break before "25" of the zoning cycle due to breaking of commutator HS—1, causing contacts R—24a, R—23a, R—4a, and R—5a to open, but the shift magnet 240 must remain energized till after printing at "80." For this purpose, coil R—6 in the shift magnet circuit closes contacts R—6a to form the following holding circuit:

Shift magnet holding circuit #1.—From the right side of the line, through magnet 240 and coil R—6 in parallel, through contacts R—6a, line 313, zoning commutator HS—3, line 310, contacts R—1b, commutator CF—1, and to the left side.

When the analyzing circuits broke, normally closed contacts R—24b, R—23b, R—4b, and R—5b returned to normal closed condition. Thus, a second holding circuit for shift magnet 240 forms as follows:

Shift magnet holding circuit #2.—From the right side, in parallel through magnet 240 and coil R—6, through contacts R—6a, contacts R—5b, R—4b, R—23b, R—24b, line 310, contacts R—1b, commutator CF—1, and to the left side.

Holding circuit #1 is timed by commutator HS—3 (Fig. 32) to form before "25" of the zoning cycle and to hold over till about "4" of the next zoning cycle. In the latter zoning cycle, a new card column is being analyzed, and the analysis is taking place while holding circuit #1 is still in effect. If this new card column is blank, no analyzing circuits will form, and contacts R—5b, R—4b, R—23b, and R—24b will remain closed to maintain holding circuit #2. Hence, in that case, after holding circuit #1 breaks, the other holding circuit remains effective to energize shift magnet 240, thereby maintaining the recording unit in upper case condition. A blank card column denotes an intraline space. Thus, if the card column, following the one which had

an alphabetic code, is blank, intraline spacing will occur with the recording apparatus still in upper case condition. If the card column following the one which produced the upper case shift also has an alphabetic designation, the making of contacts R—5a and one of the contacts R—4a, R—23a, or R—24a will precede by a slight lag the opening of contacts R—5b and R—4a, R—23a, or R—24a, causing the main circuit of shift magnet 240 to be closed before the preceding holding circuit #2 breaks. If the analyzing circuits make before commutator HS—3 opens, shift magnet holding circuit #1 will also continue uninterruptedly in effect. Thus, the shift magnet remains continuously energized while successive card columns bear alphabetic designations or when a blank card column follows an alphabetically coded column. As magnet 240 remains energized under above circumstances, the case shift mechanism remains in actuated position, instead of being repeatedly operated for each successive alphabetic column thus saving wear and tear on the case shift mechanism.

If the card column succeeding the one which caused the case shift bears a numerical code or a code which does not include one of the perforations 1 to 9 in combination with one of the perforations "12," "11," or "0," then a combination of zone and intrazone analyzing circuits will not form. In the absence of any intrazone analyzing circuit, coil R—5 is not energized and contacts R—5a remain open, so that the main shift magnet circuit cannot make. If the intrazone circuit analyzing circuit makes, then although contacts R—5a are closed, none of contacts R—24a, R—23a, or R—4a is made, so that the main circuit of the shift magnet is not closed. Hence, when commutator HS—3 breaks, holding circuit #1 of the shift magnet is broken and holding circuit #2 will also break due to opening of contacts R—5b as a result of analysis of an intrazone perforation alone, or due to opening of contacts R—4b, R—23b, or R—24b because of analysis of one of the zone points alone. The numerical code will thus be transcribed in lower case, and also such operations as are designated only by a zone point or points, as, for example, the carriage return (C. R.) operation designated by a "12" hole, the tab operation, and the high speed eject will take place with the recording unit in lower case position.

Intraline space lock.—As already explained, when none of the combs 210 is actuated, lever 218sp (Fig. 27) is normally free to move forward and operate lever 10sp to cause intraline spacing of the recording unit carriage 24 (Fig. 6). During high speed operation, none of the combs 210 is actuated, and operation of lever 218sp is not desired. For this reason, space lock magnet 230 (see Figs. 8 and 27) is provided to lock lever 218sp against operation during high speed operation of the control section.

It is also desired to lock lever 218sp against operation during program-controlled tabular spacing and carriage return operations.

Also, a gap of ten cycle points occurs between successive cards, during which none of the combs 210 is actuated, the analyzing circuit line being broken by commutator CF—1 (see Fig. 31). During each of the zoning cycles or revolutions of shaft 123 occurring within said gap, when cam 220 releases lever 218sp, forward movement of the lever, while not blocked now by combs 210, will be prevented by energization of magnet 230.

Finally, it is desired to lock the lever 218sp against operation if the main clutch is uncoupled during any zoning cycle, particularly during a zoning cycle corresponding to a cycle point occurring during the card reading period; "1" to "80" of a card cycle.

The manner in which the magnet 230 is energized, under above conditions, to lock the space lever 218sp will now be explained. The circuit for magnet 230 is as follows (middle of Fig. 34a):

Space lock magnet circuit.—From the left side, through lines 311, 312, 314, through either of the parallel contacts R—21b, R—11a, R—15a, R—12b, R—9a, or clutch arm contacts 62, through lift bail contacts 235 (also see Fig. 27), and space lock magnet 230, to the right side.

Contacts R—21b are closed during high speed eject of a card under control of a high speed eject code 12—11 in a card column (see Fig. 30).

Contacts R—11a are closed during program controlled line spacing operations.

Contacts R—15a are closed during program controlled tabular spacing operation.

Contacts R—12b are closed during high speed control by the card cycle program drum.

Contacts R—9a remain closed during the gap between card reading periods of successive card cycles.

Clutch arm contacts 62 are closed when the main clutch is at rest (see Fig. 19).

The manner in which contacts R—21b, R—11a, R—15a, and R—12b are closed to cause locking of space lever 218sp during high speed eject code control, line spacing under program control, tabular spacing under program control, and high speed under program control will be explained hereinafter.

Contacts R—9a are opened by coil R—9 energized during the card reading period of a cycle by the previously traced coil R—9 circuit. Between card reading periods, coil R—9 is deenergized, permitting contacts R—9a to close. Thus, the space lock magnet circuit will be automatically established during the ten cycle point gap between successive cards or while the brushes SB are wiping the bare contact roll 137. During this gap, shaft 123 makes ten revolutions and none of the combs 210 is actuated, but lever 218sp remains locked by magnet 230 against operation by the lift bail 221. In above manner, under control of contacts R—9a, intraline spacing of the recording unit is prevented between card reading periods.

If the main clutch is stopped, clutch arm contacts 62 make (see Fig. 19) and remain closed while the main clutch is at rest and while shaft 123 continues to rotate and perform zoning cycles. As the main clutch is at rest, the card feed has been interrupted and during this period, the circuit for magnet 230 forms through closed contacts 62. As indicated in the zoning cycle chart (Fig. 32), the main clutch disengages at "80" of the zoning cycle or after the operations under control of the last-analyzed card column have been completed. Lift bail contacts 235 do not close till "90" of this zoning cycle. At this point, with contacts 62 closed, the space lock magnet circuit forms, energizing magnet 230 to prevent forward movement of lever 218sp above lift bail 221. This circuit remains in effect till "75" of the next zoning cycle, but by then the lift bail 221 has risen and even if lever 218sp were to move forward, it would be too late for the shoulder 218a thereof to coast with the lift bail. Thus, during the zoning cycle following disengagement of the

main clutch, intraline spacing is prevented. As long as the main clutch remains disengaged, contacts 62 stay closed and the above locking action is repeated each zoning cycle. In above manner, when the main clutch is at rest and a card feed has been interrupted, intraline spacing of the record sheet on platen 20 is prevented under control of clutch arm contacts 62.

Intermediate card column carriage return code.—When an intermediate card column (between 1 and 80 or 2 through 79) is punched with a carriage return code ("12"), the sensing of this code by the analyzing means forms the previously traced "12" zone analysis circuit, energizing comb magnet 212—12, and relay coils R—4 and R—8.

Energization of comb magnet 212—12 causes operation of lever 218CR (Figs. 7, 8, 24) in turn causing lever 10—CR (Fig. 1) to operate the carriage return and incidental line spacing mechanism.

Coil R—8 closes contacts R—8b to form the following circuit (Fig. 34b):

Coil R—3 circuit.—From the left side, through zoning commutator HS—2 (see Fig. 32), line 316, relay contacts R—16a, relay contacts R—20a, contacts R—8b, coil R—3, to right side.

Coil R—3 closes contacts R—3a to form a shunt circuit operative after contacts R—8b open due to breaking of the analyzing circuit at about "24" of the zoning cycle. This shunt circuit is as follows:

Coil R—3 shunt.—From the right side, through coil R—3, contacts R—3a, left hand margin contacts 33 (also see Fig. 29), to the left side.

Coil R—3 opens contacts R—3b in the main clutch magnet circuit (Fig. 34b) so as to deenergize clutch magnet 53 for interrupting card feed at "80" of the same zoning cycle (see Fig. 32) in which the C. R. code was sensed. As the carriage return operation is effected, contacts 28 (Fig. 28) also open, causing an additional break in the main clutch magnet circuit. The card feed will now stop until the carriage return mechanism returns to normal to cause contacts 28 to reclose and until the left margin is reached, at which point the left margin stop extension 34a (Fig. 29) opens contacts 33, and the next line of the bill form is in position to start receiving the transcription from the following card column. As contacts 33 open, the stick circuit of coil R—3 opens, and contacts R—3b reclose. With termination of the carriage return, contacts 28 reclose. Now, with contacts 28 and R—3b closed, the main clutch magnet circuit is reestablished, resuming card feed.

In above manner, spaced intermediate card columns may have carriage return codes to cause the data of a single card T to be transcribed on successive lines of a bill form. It is to be noted that normally, in the absence of an intermediate card column carriage return code, all the data of a single record card will be transcribed on a single line of a bill form.

As explained before, during operation of the carriage return lever 218CR, its connected lever 224 closes switch 247 (see Figs. 7, 8, 24, and 25). Lever 218CR is elevated by bail 221 at "50" of the column cycle and almost immediately, switch 247 closes. The carriage return lever 10—CR (Fig. 1) is depressed by lifting of lever 218CR and, acting through an associated cam 12, initiates operation of the carriage return mechanism subsequently to the closure of switch 247. The carriage return mechanism, upon operation, opens carriage contacts 28 (Fig. 28) but this does not

occur till after switch 247 has been closed. During the period of the zoning cycle in which the switch 247 and contacts 28 have overlapping closure, the following circuit momentarily forms (lower portion, Fig. 34b):

Line space drum clutch circuit #1.—From the left side through contacts 28, line 315, switch 247, line space drum clutch magnet 270 (Fig. 10), to the right side.

Momentary energization of clutch magnet 270 releases the line space clutch to effect a step of advance of line space program drum 276, as explained before.

In above manner, program drum 276 is kept in step with the line spacing of the bill forms so that each drum notch 276a is moved past control position (location of pinions 288' and 294a, Fig. 22), as the corresponding line of the bill forms is moved into printing position. Thus, the thirtieth notch 276a will traverse control position as line 30 of the bill forms (supra) is moved into printing position.

Normal carriage return.—Following the passage of the last card column of each card past the analyzing means, a cyclic carriage return normally occurs. This is accomplished as follows: After the last card column has been read, commutator CF—1 (Fig. 31) breaks, thereby incidentally opening the coil R—9 circuit. As coil R—9 is deenergized, it permits the right side of transfer contacts R—9b (top of Fig. 34a) to close, which occurs after the analyzing period of column 80. After the right side of contacts R—9b closed, commutator CF—3 makes. Commutator CF—4 already has made. With commutators CF—3 and CF—4 made, the following circuit forms (top of Fig. 34a):

Coil R—26 circuit.—From the left side, through commutator CF—4, contacts R—1a, normally closed R—18b contacts, commutator CF—3, coil R—26, to the right side.

Coil R—26 now closes contacts R—26a, and with the right side of transfer contacts R—9b already closed, the following circuit is established (upper part of Fig. 34a):

Normal C. R. circuit.—From the right side, through coils R—4, R—8, in parallel through magnet 325 and comb magnet 212—12, the right side of contacts R—9b, contacts R—26a, contacts R—1a, commutator CF—4, and to the left side.

As a result of energization of magnet 212—12, a carriage return operation occurs. This normal, cyclic carriage return is effected at the end of each card reading period, in the absence of a C. R. (carriage return) code "12" in the last card column or column 80. As an incident to the normal or cyclic carriage return, card feed is interrupted under control of the coil R—3 circuits, formed in the manner explained in connection with the intermediate column carriage return operations.

Repeat carriage return operation.—If a carriage return code "12" occurs in the last (80th) card column, a plurality of carriage return operations are effected under control of program drum 276 (Figs. 1, 10, and 22).

In the present case, the program drum has ninety slots in which control clips 277 may be set at will, and each slot corresponds to a line of the bill forms. For each line spacing of the bill, the drum 276 is advanced from one notch to the next with respect to a reference point. The number of lines assigned to a series of bills to be controlled by one revolution of drum 276 is equal to the number of notches of the drum. For in-

stance, with ninety notches in the drum to control a series of two bills, each bill would have forty-five lines, a series of three bills would provide thirty lines to each bill, a series of five bills would provide eighteen lines apiece, a series of six bills would provide fifteen lines apiece, a series of ten bills would provide nine lines for each bill, a series of fifteen bills would provide six lines apiece, and so on. The drum, in one revolution, is stepped in synchronism with one series of bills, and during each succeeding revolution covers a similar series of bills. It is also possible to control by each revolution of drum 276 the line spacing of a series of successive bills having an unequal number of lines but the total of which equals the number of notches of the drum. For instance, the first bill of a series may be required to have thirty lines, the second to have twenty lines, the third to have twenty-five lines, and the fourth to have fifteen lines. The total number of lines of these bills is ninety, so that one revolution of drum 276 would control one such series, and the repeat revolutions of the drum would cover successive similar series.

It is understood, of course, that the number of slots of drum 276 may be varied, and its drive varied so as to advance the drum in steps corresponding to the number of slots. Further, it is to be understood that it is possible to step the drum the distance of a multiple number of notches so that during successive revolutions, alternate notches will be in control positions.

In the preferred embodiment, drum 276 has ninety notches and is advanced each step from one notch to the next as an incident to each carriage return and line spacing operation. In the example given hereinbefore, the bills are arranged in series of three, each bill occupying thirty lines, so that one revolution of drum 276 corresponds to the spacing of the series of three bills past printing position. As indicated in the example, the first item on each bill is printed on the corresponding first lines of the successive bills. Thus the first item of the first bill of the series is on line 1, of the second bill is on line 31 (thirty lines away from the corresponding line of the first bill), and the first line of the third bill is on line 61. The last possible heading item of each bill is on the seventh line of each bill. Thus, the heading field occupies lines 1 through 7 of each bill. The first detail item of each bill is on the thirteenth line thereof and the detail field occupies lines 13 through 25 of the first bill and the corresponding lines of the other bills of the series. The total item is on the twenty-sixth line of each bill.

Thus, in the given example, the last heading item of the first bill is on line 7. The recording of this item is to be followed by a skip or multiple line spacing to line 13 to receive the first detail item. The extent of the skip is controlled by a clip 277 (Fig. 22) set in drum notch "13" corresponding to the first detail line. As previously explained, normally closed contacts 292 (also see Fig. 23) control multiple line spacing. When the clip set in drum notch "13" traverses pinion 288a (Fig. 22), it turns the pinion to cause contacts 292 to momentarily open, and the opening of these contacts interrupts line spacing operations as line 13 of the bill arrives at printing position, ready to receive the first detail item record. To initiate line spacing under control of drum 276, a carriage return or C. R. code ("12") is punched either in the last (80th) col-

umn of the last heading card or in the first column of the first detail card. The skipping may be initiated not only after the recording of the last heading line 7 but after recording of any other heading line, depending on the number or lines of heading items to be recorded, but in any event, the skipping will proceed to line 13. Assume the last heading card has a C. R. code in column "80." When this code is sensed by brushes SB, a "12" zone analysis circuit is formed, energizing comb magnet 212 and relay coils R-4 and R-8 (see Fig. 34a). Magnet 212-12 effects a carriage return and line spacing operation, and as an incident thereto, drum 276 is advanced one step, in the manner previously explained under the heading "Intermediate card column carriage return code." During the 80th cycle point, commutator CF-2 is made (see Fig. 31). Also coil R-8 of the "12" zone analysis circuit formed during the 80th cycle point, as above described, now closes relay contacts R-8a. With contacts R-8a closed and commutator CF-2 made, the following circuit forms (upper portion of Fig. 34b):

C. R. repeat control circuit.—From the left side, through normally closed program contacts 292, commutator CF-2, contacts R-8a, normally closed R-5c contacts, and coils R-10 and R-11, to the right side.

Shortly before "25" (see Fig. 32) of the 80th cycle point, the "12" Zone analysis circuit breaks, coil R-8 is deenergized, and contacts R-8a open. But a C. R. repeat control stick circuit is maintained through coils R-10 and R-11 as long as contacts 292 remain closed—due to closing of contacts R-10a, which by-passes contacts R-8a, R-5c, and commutator CF-2.

Coil R-10 opens contacts R-10b in the main clutch magnet circuit (Fig. 34a), causing feed of the card to be interrupted at "80" of the zoning cycle (see Fig. 32). Thus, during closure of the C. R. repeat control circuit, card feed is stopped. Coil R-10 also closes contacts R-10c to form the following circuit (lower portion of Fig. 34a):

Coil R-18 circuit.—From the left side, through line 311, contacts R-10c, and coil R-18, to the right side.

Coil R-18 closes stick contacts R-18a, by-passing contacts R-10a, to form the following stick circuit:

Coil R-18 holding circuit.—From the left side, through commutator CF-8, contacts R-18a, and coil R-18, to the right side.

Thus, coil R-18 will remain energized till commutator CF-8 breaks during the 87th cycle point (see Fig. 31) after the repeat C. R. operations have been completed and card feed resumed. Commutator CF-3 is made during "82" of the card cycle upon resumption of card feed but does not result in the formation of a normal C. R. circuit because contacts R-18b in this circuit (see upper portion of Fig. 34a) are held open by coil R-18 until commutator CF-8 breaks, by which time the commutator CF-3 already has broken. In this manner, the normal carriage return following passage of a card will be prevented, so that after the repeat line spacing has been completed to bring the first detail line to printing position, and card feed is resumed, an additional, normal carriage return will not be effected to space the bill to the next line.

Coil R-11, energized by the C. R. repeat control circuit, closes contacts R-11a to form the space lock magnet circuit, energizing magnet 230

to prevent intraline spacing during the revolutions of shaft 123 occurring while the repeat line spacing is being effected.

Due to the C. R. operation effected under control of the "12" perforation in column "80" of the last heading card, the bill form is brought back to the beginning of the line following the last heading item line. In the given example, the first bill will have been brought to line 8. From this point on, the successive line spacing operations to bring the bill to the first detail line, line 13, are effected according to the selected program and independently of the card.

Thus, coil R-11 closes contacts R-11b to form the following circuit (upper part of Fig. 34a):

C. R. repeat circuit.—From the right side, through coils R-4, R-8, comb magnet 212-12, contacts R-11b, half speed commutator I. C. (see Fig. 5), relay contacts R-1a, and commutator CF-4, to the left side.

Commutator I. C. times the C. R. repeat circuit and makes every alternate zoning cycle (see Fig. 33), allowing sufficient time for the operations attendant upon a carriage return to be completed before the next carriage return is initiated by the repeating of the C. R. repeat circuit.

Each closure of the C. R. repeat circuit energizes comb magnet 212-12 to cause a line spacing operation to occur. As an incident to each line spacing operation, program drum 276 is advanced one step in synchronism with the line spacing. This is done in the manner previously explained, in connection with the intermediate column carriage return code, by the closure of the line space drum clutch circuit #1 due to closure of contacts 247 by the carriage return lever 218CR. The latter circuit forms shortly after "50" of a zoning cycle and energizes drum clutch magnet 270 (Fig. 10) to release drum 276 for one step of advance for each line spacing operation.

The line spacing operations are repeated until the first detail line moves into printing position, which, in the given example, is line 13 of the first bill. Shortly after "50" of the zoning cycle in which line 13 is brought to printing position, the drum clutch 270 is energized to release drum 276 for one step of advance during which drum notch 276a-13, in which a clip 277 has been set, moves past control position. During this step of advance of drum 276, the clip 277 in notch 13 engages pinion 288a (Fig. 22), causing contacts 292 to break at "90" of the same zoning cycle (see Fig. 33). Due to opening of contacts 292, the C. R. repeat control stick circuit breaks, deenergizing coils R-10 and R-11. Consequently, contacts R-11b in the C. R. repeat circuit open, breaking the latter circuit. Contacts 292 make again at "25" of the next zoning cycle after the one in which the contacts were opened but by then, stick contacts R-10a have opened, so that the C. R. repeat control circuit cannot form again until a C. R. code is again sensed in the last column of a card. Contacts R-10b in the main clutch magnet circuit reclose at "90" of the zoning cycle in which the last repeat line spacing was effected, but the main clutch does not pick up the card feed until "80" of the next zoning cycle.

Coil R-11, being deenergized, permits contacts R-11a to reopen, breaking the space lock magnet circuit through these contacts. However, as

the main clutch is still at rest, the latter circuit is still maintained through clutch arm contacts 62, and further, since the last card cycle was interrupted at cycle point "81" or within the gap between cards, coil R—9 is deenergized and contacts R—9a are closed to maintain the space lock magnet circuit in effect.

After the card feed resumes, commutator CF—8 breaks to open the coil R—18 circuit during the 87th cycle point.

The repeat line spacing has been explained as initiated by a C. R. code in the last column of the last heading card. Instead, the repeat line spacing may be initiated by a C. R. code in column 1 of the first detail card. During the card cycle preceding the arrival of column 1 of the first detail card at analyzing position, a normal C. R. circuit will have been established, effecting carriage return and line spacing after printing of the last heading item. Thus, in the given example, the bill form will be in line 8 position while the C. R. code in column 1 of the first detail card is being sensed. The sensing of this code establishes a "12" zone analysis circuit to effect line spacing to line 9. Also, as coil R—8 of the latter circuit is energized, contacts R—8a close and establish the C. R. repeat control circuit through commutator CF—7 (Fig. 34b) which makes during the first cycle point (see Fig. 31). The repeat line spacing operations previously described now occur in the same sequence, except that the coil R—18 holding circuit does not form and is unnecessary. The card feed is interrupted after analysis of the 1st card column and does not resume until the bill form has been spaced to line 13 position.

In a similar manner, repeat line spacing is controlled by program drum 276 through contacts 292 after the printing of the last detail item in order to bring the total line to printing position, and after the total printing to bring the first line of the next bill form to printing position. For the first bill of a series in the given example, clips 277 for opening contacts 292 will be placed in drum notches 276a—1 (first heading line), 276a—13 (first detail line), and 276a—26 (total line). For the second bill, the clips 277 for controlling corresponding spacing will be thirty notches from the corresponding clips or in notches 276a—31, 43, and 56. For the third bill, clips 277 will be in notches 276a—61, 73, and 86. These clips thus control a series of bills, such as described hereinbefore as illustrative, each bill occupying thirty line spaces.

Tabular spacing by card code.—Tabular spacing may be controlled by an "11" code in a card column (see Fig. 30). Sensing of this code forms the "11" zone analysis circuit, energizing coils R—20 and R—23 and comb magnet 212—11. The latter causes lever 218TAB (Fig. 7) to be released for operation, causing lever 10—TAB (Fig. 1) to effect operation of the tabular spacing mechanism.

Energization of coil R—20 closes contacts R—20c to form the following circuit (upper center of Fig. 34b):

Coil R—22 circuit.—From the right side, through coil R—22, contacts R—24c, R—20c, and contacts R—8c, R—19a, and R—16a, through line 316, commutator HS—2, to the left side.

Coil R—22 closes contacts R—22a to form a shunt circuit through commutator HS—2, which

by-passes contacts R—24c, R—20c, R—8c, R—19a, and R—16a. As a result, coil R—22 will remain energized until commutator HS—2 opens at about "0" of the next zoning cycle. Coil R—22 opens contacts R—22b in the main clutch magnet circuit to cause interruption of card feed at "80" of the same zoning cycle in which the TAB code was sensed. Coil R—22 is not deenergized till commutator HS—2 opens, so that card feed cannot resume till at least one zoning cycle has elapsed after the feed was interrupted.

The operation of the tabular spacing mechanism also opens contacts 28 (Fig. 28), additionally opening the main clutch magnet circuit until the tabular spacing has been completed.

The tabular spacing under control of an "11" hole in a card column usually occurs only during the printing of the heading and of the total. The detail items are printed in spaced lists and the tabular spacing for this purpose is controlled by card cycle program drum 144 (Figs. 1, 12 and 13) in accordance with the setting of clips 147 of the form adapted to engage cam lug 150a of block 150 to close contacts 153 (see Fig. 14).

Program controlled tabular spacing.—Clips 147 are set in notches of drum 144 corresponding to the card columns at which automatic, program tabular spacing control is to begin. The program tabular spacing control is effective to allocate the corresponding detail items of successive detail cards to the same vertical fields. Thus, the code numbers of all the individual items are all recorded in the first left hand vertical field, the quantities in the next vertical field, the descriptions in a description field, the unit prices in the next field, and the total prices in the last field. As indicated in the previously described examples of a series of bills, the descriptions of individual items vary in length, and the drum clip 147 for controlling tabular spacing from the description field to the next field is set in a drum notch corresponding to the last column in which a designation of the description may occur. Beyond this column, none of the detail cards is to bear any designations representing descriptive matter. It should be made clear now that the lateral spacing between the successively horizontally displaced lists on the bill forms is not equivalent to the number of card columns between the column bearing the last designation of one list and the column bearing the first designation of the next list. Thus, in the given example, in the second bill, the last detail item ending with "Blades," the last letter "S" is printed under control of a designation in card column "30," while the "0" of the next or unit price list is printed under control of a designation in column 75. Also in the same detail line, the quantity number "36" is printed under control of designations in columns "5" and "6" while the next designation "2" of the description field is printed under control of a designation in column "7" although a tabular spacing occurs between the reading out of columns 6 and 7 to space "36" of the quantity field laterally from "24" of the description field.

The control by drum 144 of the tabular spacing is to be effected only for the detail items. Each detail line is printed under control of one detail card T. One such card passes through the control section each card cycle, and since program drum 144 makes one revolution during the same cycle, the control by the drum will be repeated each card cycle during which a detail card is

read out. Assuming that a program tabular spacing is to occur after the reading out of column 6 of a detail card, then a clip 147 for acting on cam block 150 to close contacts 153 (see Fig. 14) is set on drum 144 in the notch "6" of this drum. Analysis of the column 6 item is completed at "24" of the sixth cycle point. The aforementioned clip 147 set in the sixth drum notch rides past cam lug 150a, causing contacts 153 to close at "25" of the sixth cycle point (see Fig. 32). As a result of closure of contacts 153, the following circuit is formed (middle of Fig. 34b):

Program tabular control circuit.—From the left side, through contacts 296 (closed during detail card cycles under control of the line space program drum 276; see Figs. 22 and 23) or alternatively through a hand switch 320 (closed when the control by drum 276 is to be suppressed), contacts R—2c (see the card lever circuit and card lever shunt circuit), tabular control contacts 153, and coils R—14 and R—15, to the right side.

During the card cycles of operation on detail cards, contacts 296 are closed, and the following circuit is effective (Fig. 34b):

Coil R—19 circuit.—From the left side, through contacts 296, contacts R—2c, and coil R—19, to the right side.

Coil R—19 opens contacts R—19a to prevent formation of a coil R—22 circuit when contacts R—20c close subsequently due to energization of coil R—20 by the program tabular circuit, which will be traced later. As coil R—22 is prevented from energizing, contacts R—22b will not open and the breaking of the main clutch magnet circuit, with consequent cessation of card feed, will not occur under control of the coil R—22 circuit. Instead, the card feed is interrupted by opening of contacts R—14c due to energization of coil R—14 by the program tabular control circuit. This occurs at "25" of the zoning cycle during which the last card column pertaining to one list was analyzed, so that the card feed will stop at "80" of the latter zoning cycle.

The program tabular control circuit has energized coil R—15, which closes contacts R—15a (Fig. 34a) to form the space lock magnet circuit during the revolutions of shaft 123 within the period of interrupted card feed. Then, upon latching up of the main clutch, clutch arm contacts 62 close also to maintain space lock magnet 230 energized while the card is at rest.

Coil R—14 was energized by the program tabular control circuit at "25" of the sixth cycle point, after reading out of the sixth card column code and breaking of the analyzing circuit by opening of commutator HS—1. The transcribing operations incidental to analysis of this code are carried through to completion by the zoning and recording system in the manner described before. Thus, the sixth column code will be transcribed during the zoning cycle corresponding to the sixth cycle point and, meanwhile, coil R—14 is energized to prepare the transcribing unit for a tabular operation. Coil R—14, upon energization, closes contacts R—14a to bypass program drum contacts 153, contacts R—2c, and line space program drum contacts 296, through line 321 and carriage contacts 28 (Fig. 34b). Coil R—14 also closes the left side of transfer contacts R—14b (upper portion of Fig. 34a) and during the next zoning cycle, while the card is at rest, closure of commutator HS—1 forms the following circuit (Fig. 34a):

Program tabular circuit.—From the right side, through coils R—23, R—20, through parallel magnets 325 and 212—11, the left side of contacts R—14b, commutator HS—1, contacts R—1b, commutator CF—1, and to the left side.

The above circuit energizes comb magnet 212—11 to cause a tabular operation of the recording unit, the extent of which is governed by the setting of a tab stop, and which brings the next vertical detail field to printing position. Once the tabular operation is initiated, it continues until the tabular spacing is completed at which point the tab stop, in accordance with its setting, restores the tabular mechanism to inactive position. As the tabular mechanism operates, contacts 28 open, breaking the stick circuit of coils R—14 and R—15. Although contacts R—14c now close, the main clutch magnet circuit is not reestablished until contacts 28 reclose at the end of the tabular operation. Thus, card feed cannot resume until tabular spacing is completed.

The program drum 144 is intended to control tabulating only for the detail item listing cards. The heading and total items are not in list form and during the cycles of passage of heading or total cards, tabulating control by drum 144 is suppressed. For this purpose, when a line of the heading space of the bill or the total line is at printing position, contacts 296 controlled by line space program drum 276 are open. Thus, since line 31 of the second bill in the hereinbefore described series is the first line of the heading field, a clip 277 for operating contacts 296 may be set on the drum 276 in the notch "31." As line 31 moves to printing position, this clip 277 rides past pinion 294a (Fig. 22) and turns sleeve 294 to diagonal position for opening 296 at "90" of the same zoning cycle during which the line spacing or carriage return operation for bringing line 31 to printing position is effected. Contacts 296 now remain open throughout the transcription of the heading cards, thereby preventing formation of the program tabular control circuit, thus suppressing program tabular spacing during the heading card cycles.

In a similar manner, program tabular spacing is suppressed for the total line by the opening of contacts 296 by a clip set on drum 276 in a notch corresponding to the total line.

It may be pointed out that when, as in the assumed example, both the total and heading fields are not to have program tabular spacing, the clip 277 for opening contacts 296 may be set in any notch of drum 276 following the last possible detail line and preceding or including the total line. This will suppress program tabular spacing until the next clip 277 on drum 276 recloses contacts 296. Since program tabular spacing is not to resume until the first line of the detail field is moved to printing position, this next clip 277 is set in a notch corresponding to the first detail line of the following bill form. Thus, for the second bill of the assumed series, the first detail line is line 43 and a clip 277 is set on drum 276 in corresponding notch "43." After "50" of the zoning cycle in which the repeat line spacing operation for bringing the first detail line to printing position is effected, this next clip 277 rides past pinion 294a and turns sleeve 294 to flat position with respect to contacts 296, causing the latter to make at "25" of the next zoning cycle (Fig. 33). These contacts 296 now stay closed during transcription of detail cards. As previously explained under the heading re-

peat carriage return operation, the repeat line spacing is interrupted by opening of contacts 292 at "90" of the same zoning cycle in which the last C. R. repeat circuit is formed. This opening is effected by a clip 277 on drum 276 riding past pinion 288a (Fig. 22). Thus, when the bill spaces to the total line—"56" of the second bill in the series—a clip 277 rides past pinion 288a opening contacts 292 to interrupt the C. R. repeat holding circuit. Preceding the arrival of the total line at the printing position or as the total line is moved into printing position, contacts 296 must open to suppress program or cyclic tabular spacing while the total is being printed. If this is to be effected as the total line moves to printing position, then a clip 277 is set in the notch of drum 276 corresponding to the total line and opens contacts 296 at "90" of the same zoning cycle in which the last line spacing operation is effected. Contacts 292 must be opened by a clip 277 at "90" of the same zoning cycle to interrupt program line spacing. Since contacts 292 and 296 are to be opened at the same time by a clip 277, a wide head clip 277 may be set in the drum notch 276a corresponding to the total line; i. e., line 56 of the second bill in the assumed series. This single wide clip simultaneously operates pinions 288a and 294a to open contacts 292 and 296 during the same zoning cycle.

When the heading is completed, repeat line spacing is effected to bring the first detail line to printing position. At the same time, to prepare program tabular spacing for operation, contacts 296 must be closed either before the first detail line of the bill form reaches printing position or just as it is moved into printing position. In the latter case, a single wide clip 277 may be set on drum 276 in the notch corresponding to the first detail line. During the zoning cycle in which the last program line spacing occurs to bring the first detail line to printing position, this clip 277 at "90" of this zoning cycle causes contacts 292 to break for interrupting further program line spacing, while the same clip also operates on pinion 294a to cause contacts 296 to make at "25" of the next zoning cycle. Meanwhile, as previously explained, the card feed has been interrupted by the last C. R. operation and does not begin again till the line spacing of the first detail line to printing position is completed. This last line spacing operation began in the zoning cycle during which the clip 277 acted on the pinions 288a and 294a, and contacts R—10 in the main clutch magnet circuit do not open till contacts 292 open at "90" of the latter zoning cycle. Hence, the card feed does not resume till "80" of the next zoning cycle, after the contacts 296 are opened at "25" of the latter cycle. Thus, the contacts 296 are closed for preparing the program tabular control circuit for operation before the feed of the first detail card begins and analysis of the detail items thereof occurs. It should be noted that when the program line spacing is initiated by a C. R. code in the first column of the detail card, feed of this card already has begun, and if cyclic tabular spacing is to begin in the second column or cycle point of the first detail card cycle, the second column of this card must first be fed past the analyzing means, since in the cycle point, the program contacts 153 are to be closed at "25." This is after the code in the second column of the first detail card has been read out to start the transcribing of the code which is then completed although the tabular spacing contacts 153 have been closed. Thus if it is de-

sired to start tabular spacing before the second, or even first, column of the first detail card has been read out, the program line spacings should be initiated by a C. R. code in the last column of the last heading card. After the detail cards for one bill have been transcribed, program line spacing begins to space the bill for bringing the total line to printing position. If desired, a wide clip 277 may be set on drum 276 in the notch corresponding to the total line to cause contacts 292 and 296 to open simultaneously, respectively interrupting program line spacing and suppressing program tabular spacing, as explained above. If desired, a narrow clip 277 may be set in a notch of drum 276 corresponding to a line following the last possible detail line and preceding the total line for opening contacts 296 to suppress the program tabular spacing. Another narrow clip 277 will then be set in the notch corresponding to the total line to cause contacts 292 alone to open for interrupting program line spacing.

High speed clutch control.—It may be desired to skip unused, intermediate, or end fields of card columns. For instance, if a group or field of each of the item cards bears data, such as the code number of the salesman, which are not to be listed, or if these columns are blank, it is desirable to move these columns past the analyzing station at high speed and without formation of analyzing circuits. When only a list of items is to be printed and no headings are to be recorded, the high speed clutch operation and suppression of analyzing action is placed under control of program drum 144, without any provision being made for varying such control for certain cards. However, when cards bearing headings or other matter, not to be skipped, are to be interposed between the item cards, which have skip fields, then for the cards not having skip fields provision is made for suppressing high speed clutch and analyzing control by the card cycle program drum 144. This suppression is caused by opening of line space program contacts 296, previously described, and is to occur for certain cards, the data of which is to record on predetermined lines of the record forms, so that line space program drum 276 will be in known positions during passage of the latter cards through the machine. By placing clips 277 in the notches, of drum 276, corresponding to the predetermined lines of the form for which high speed operation is not desired, contacts 296 are opened to suppress high speed operation, in a manner which will be explained hereinafter.

To effect program control of high speed skipping of selected fields of columns, a pair of clips 147 are set on drum 144 (Figs. 1, 12, and 13) of the kind for engaging and rotating pinions 163a, 155a (see also Fig. 16). The leading clip (in a counterclockwise direction, Fig. 13) is set in the drum notch corresponding to the last low speed column and the following clip in the notch corresponding to the last high speed column. As will be brought out further on, a high speed skip when started must continue for at least ten card columns or a multiple thereof. Thus, if the ten columns 11 to 20, inclusive, are to be skipped, the leading clip 147 is set in the "10" notch (last low speed point of the card cycle) and the following clip in the "20" drum notch (last high speed cycle point).

Drum 144 moves counterclockwise (Fig. 13) and pinion 163a is at a distance preceding pinion 155a the equivalent of five full cycle points. The leading clip 147 rides past pinion 163a five full

cycle points before the high speed skip begins. Thus, if the first clip is set in notch "10," as in the assumed example, this clip will ride past pinion 163a five full cycle points previous to the "10" cycle point or during the "5" cycle point. As clip 147 rides past pinion 163a, it turns sleeve 163 to flat position with respect to contacts 167, causing the latter to make at "25" of the "5" cycle point (see Fig. 32). Contacts 167 are in series with the high speed clutch magnet 91 (see the lower portion of Fig. 34a) but the making of contacts 167 does not by itself cause high speed action to begin since contacts R-13a are still open. Five full cycle points after contacts 167 are closed, the leading clip 147 rides past pinion 155a, turning sleeve 155 to flat position for causing contacts 160 to close at "25" of the "10" cycle point (see Fig. 32). This is after the analysis of card column 10 has been completed and the transcription of the column code determined. The transcription proceeds to completion under control of the parts actuated by zoning system shaft 123 which is operating continuously and at a constant speed (one revolution each cycle point).

Contacts 160 close at "25" of the "10" cycle point and when commutator HS-4 closes at "30" (see Fig. 32), the following circuit is formed (middle of Fig. 34b):

Program H. S. (high speed) initiating circuit.—From the left side, through line space drum 296 (closed now because a detail card is being transcribed) or through switch 320 (when control by the line space program drum contacts is to be suppressed, as when only item or detail cards are being transcribed and no heading or total cards or the like are to be acted on), through contacts R-2c (closed by the card lever and card lever shunt circuits), card cycle program contacts 160, commutator HS-4, and relay coils R-12 and R-13, to the right side.

Coil R-13 now closes contacts R-13a to form the following circuit (lower part of Fig. 34a):

Program H. S. skip circuit.—From the right side, through high speed clutch magnet 91, previously closed card cycle program contacts 167, relay contacts R-13a, line 311, and to the left side.

Thus, at "30" of the "10" cycle point, magnet 91 is energized, but as indicated in Fig. 32, high speed clutch pawl 75 does not engage ratchet 76 (see Figs. 5 and 18) till "80" of the same cycle point. Thus, the high speed action on the card begins at "80" of the "10" cycle point. Through the differential gearing, described before, and including elements 68, 67, 66, 69, and 70 (Figs. 5 and 11), the high speed clutch is now driving shaft 71 at the same speed as shaft 44, causing the card feeding means to operate at ten times the normal speed, so that ten card columns traverse the analyzing station during the same time that it takes one column to pass at normal speed. There are four teeth on ratchet 76 of the high speed clutch and this ratchet is on shaft 44 which makes one-fourth of a revolution for each revolution of shaft 123 of the zoning system or for each normal cycle or column point. This one-fourth of a revolution during normal speed operation of the card feeding means causes the card feeding means to feed only one card column of the card through the analyzing station. During high speed clutch operation, the card feeding means is driven at ten times normal speed, so that for each quarter turn of shaft 44, and its ratchet 76, ten card columns pass the analyzing

station. Disengagement of clutch pawl 75 from ratchet 76 is effected by deenergization of magnet 91 to cause detent 80 to intercept an arm 78a of the high speed clutch disk 78. There are four such arms on the disk, and since the disk is traveling at the same speed as ratchet 76, the distance between successive arms 78a also corresponds to ten high speed driven card columns. Hence, after release of one arm 78a has initiated high speed card feed, the engagement of the next arm 78a cannot cause declutching till ten card columns have traversed the analyzing station at high speed. Thus, in the present embodiment of the differential drive and clutch ratchet means, a minimum of ten card columns must be skipped after initiation of high speed clutch action. Any multiple of such ten card columns may be skipped at high speed, depending on the time of deenergization of magnet 91 to cause detent 80 (Figs. 18 and 20) to intercept an arm 78a. It is understood, however, the minimum number of card columns to be skipped at high speed may be varied by varying the number of teeth of ratchet 76 and the number of arms of disk 78, and by varying the differential drive ratio. To avoid any lag in pick-up and release between the high speed and main clutches, if the number of teeth of ratchet 76 are varied, the number of teeth of ratchet 45 should be changed correspondingly.

The program H. S. initiating circuit energized coil R-13 to close contacts R-13a to form the program H. S. skip circuit. In addition, coil R-13 opens contacts R-13b, (upper part of Fig. 34a) to prevent any analyzing circuits being formed during high speed skip. Thus, after "30" of the "10" cycle point at which high speed skip was initiated, the analyzing circuits cannot form and the presence of perforations in any of the skipped columns is ignored.

Besides energizing coil R-13, the program H. S. initiating circuit energized coil R-12. The latter closed stick contacts R-12a (middle of Fig. 34b) to by-pass commutator HS-4, so that opening of the program H. S. initiating circuit through coils R-12 and R-13 is now dependent only on the opening of program contacts 160.

Coil R-12 also closes contacts R-12b (Fig. 34a) to form a space lock magnet circuit, preventing intraline spacing during high speed skip.

In the assumed example of a high speed skip of columns 11 to 20, the first H. S. control clip 147 was set in notch "10," corresponding to the last normal speed card column and the following clip in the notch "20" corresponding to the last high speed column. The high speed skip began at "80" of the "10" cycle, and since ten card columns now traverse the analyzing station during one zoning cycle or revolution of shaft 123, the high speed clutch is not disengaged till "80" of the zoning cycle following the one in which the skip started. To initiate deenergization of H. S. clutch magnet 91, the second control clip 147 is set in notch "20." This second clip rides past gear 163a (Fig. 13) and opens contacts 167 as the fifth skip column or card column "15" in the example is traversing the analyzing station. With opening of contacts 167, the program H. S. skip circuit opens, causing H. S. magnet 91 to be deenergized, thereby placing detent 80 (Figs. 18 and 20) in position to intercept the next arm 78a of the H. S. clutch disk 78. This deenergization of magnet 91 five cycle points before the high speed skip is to terminate provides sufficient lag between restoration of detent 80 to intercepting position and arrival of the next arm

78a of disk 78 at the detent to assure the detent being completely set in intercepting position before the latter arm arrives at the detent. This assurance is desired because of the high speed at which the high speed clutch is operated, and the consequent short interval between the arrival of successive arms 78a at the detent position. In the present case, this interval is only about one-tenth of a second.

The detent 80 has been placed in intercepting position as the "15" card column is traversing the analyzing station. As the "20" card column is traversing the analyzing station, the aforesaid next arm 78a meets the now restored detent 80 and disk 78 is rocked thereby to declutch the H. S. clutch after the perforation portion of card column "20" passes the analyzing station. The H. S. clutch was engaged at "80" of the "10" cycle point and during the next revolution of shaft 123, ten card columns traverse the analyzing station at high speed. Thus, when column "20" is passing the analyzing station, arm 78a is intercepted by detent 80, causing the H. S. clutch to disengage at "80" of the aforesaid next revolution of shaft 123 (see Fig. 32). The H. S. clutch is stopped in definite position by latch pawls 85 and 86 (Fig. 18) as previously explained.

The second clip 147, after causing contacts 167 to open, rides past pinion 155a and causes contacts 160 to break at "90" of the zoning cycle in which the normal card feed resumes. As the latter contacts open, the program H. S. initiating circuit breaks, causing coils R-12 and R-13 to be deenergized. As coil R-13 is deenergized, contacts R-13b of the analyzing circuits reclose so that during the next zoning cycle, when card column "21" traverses the analyzing station, analyzing circuits may be formed under control of the perforations in the card column.

Coil R-12, upon deenergization, drops stick contacts R-12a, so that a succeeding program H. S. initiating circuit cannot be reestablished except under control of a third clip 147 on drum 144 of the form adapted to engage pinions 163a and 155a.

The line space program drum 276 opens contacts 296, as previously explained, during the feed of heading cards through the machine. This suppresses either or both tabulating and speed control by card cycle program drum 144, preventing formation of the program tabular spacing control or H. S. initiating circuits. Line space program drum 276 opens contacts 292 to break the repeat line space circuit initiated by a carriage return code in the 80th or 1st column of a card. Assuming that a heading card is being operated on and that it is provided with code "12" in the 80th column, then drum contacts 296 are open during the feed of this card. When the code "12" in the 80th card column is sensed, it initiates repeat line spacing. When the first line of the detail or item field is reached, program drum 276 causes contacts 292 to open and break the C. R. repeat holding circuit, stopping program line spacing. Drum contacts 296 may be closed simultaneously by a wide clip 277 to enable the drum 144 to control high speed skip or tabulating operation for the item cards.

If instead of the heading card having a C. R. ("12") code in the 80th column, the next, item card has a C. R. code in the 1st column, repeat line spacing will occur as before, and will be stopped by opening of contacts 292 under control of program drum 276. Simultaneously, drum contacts 296 may be reclosed to enable

drum 144 to control high speed skip and tabulating operations.

A single wide clip 277 may open contacts 292 to stop repeat line spacing from the last detail line to the total line and simultaneously open contacts 296 to prevent either high speed skip or tabulating operation under control of the program drum 144 during the passage of the total and heading cards.

High speed eject.—Instead of or in addition to controlling high speed clutching by program drum 144, high speed clutch action may be initiated by a high speed eject code "12-11" in a card column in order to skip a field of blank card columns. Analysis of this code forms the "12" and "11" zone analyzing circuits, causing coils R-8, R-4, R-20, and R-23 to be energized.

Coils R-8 and R-20 respectively close contacts R-8d and R-20b to form the following circuit (bottom of Fig. 34a):

H. S. eject control circuit.—From the right side, through coil R-21, contacts R-20b, R-8d, card cycle commutator CF-6, contacts R-7a, stacker contacts 203, stop key contacts SK, and contacts R-2b, to the left side.

Coil R-21 closes contacts R-21b to form a space lock magnet circuit through the intraline space lock magnet 230, preventing intraline spacing during high speed feed of the card.

Coil R-21 also closes contacts R-21a and contacts R-21c to by-pass contacts R-8d and R-20b, through the following stick circuit (Fig. 34a):

H. S. eject control stick circuit.—From the right side, through coil R-21, contacts R-21a, contacts R-21c, commutator CF-6, and as in the preceding circuit.

Thus, after the H. S. eject code analyzing circuits break, causing coils R-8 and R-20 to be deenergized, the relay coil R-21 will remain energized by above circuit until commutator CF-6 breaks.

Parallel with above circuit, a circuit is formed as follows (Fig. 34a):

H. S. eject circuit.—From the right side, through high speed clutch magnet 91, through contacts R-21c, commutator CF-6, and as in the H. S. eject control circuit, to the left side.

The high speed clutch magnet causes the high speed clutch to take effect at "80" of the zoning cycle in which the H. S. eject code was analyzed. The continuation of the high speed action of the card feed is then dependent upon the commutator CF-6, and the number of card columns ejected at high speed is a multiple of ten, since, as previously explained, each quarter turn of high speed clutch disk 78 is equivalent to a high speed feed of ten card columns. Thus, if the high speed eject code occurs in card column "45," the high speed clutch magnet 91 will be energized to start high speed card feed at "80" of the 45th cycle point. The commutator CF-6 breaks and deenergizes magnet 91 at the 69th cycle point but this is after the high speed clutch has made its second quarter turn so that detent 80 will not engage an arm 78a (Fig. 18) until the high speed clutch has made a third quarter turn. Thus, the high speed clutch will have made three quarter turns since it was started at "80" of the 45th cycle point, so that thirty card columns will have been fed past the analyzing means at high speed. Near the end of the third quarter turn of the high speed clutch, an arm 78a will have engaged detent 80, causing the

high speed clutch to uncouple at "80" of the 75th cycle point, and normal card feed will resume to feed column 76 past the analyzing means. In above manner, a high-speed eject code in card column 45 has caused high speed skip of columns 46 through 75. The last card column in which a high speed eject code should be punched is column 68. The high speed clutch will then engage at "80" of cycle point "68" while commutator CF-6 is still made, and will be uncoupled at "80" of the 78th cycle point. Thus, it is assured that card columns 79 and 80 will always move through the analyzing means at normal speed. This is desirable in order to take care of a carriage return code punched in column "80" of the card which has been fed at high speed. Thus, if the last heading card is ejected at high speed, the C. R. code in column "80" thereof will be sensed at normal speed in order to initiate the program line spacing to bring the detail field to printing position.

Zero elimination.—As previously explained, clips 147 may be set on drum 144 (Figs. 12 and 13) to ride past pinion 168 and turn the latter to cause contacts 172 (Fig. 15) to close for effecting elimination of zero printing before the first significant digit of a numeral quantity. Thus, if card columns 50 to 58, inclusive, constitute a numerical card field the preceding column 49 is to be sensed in the normal manner for a zero code, and a clip 147 is set in the drum notch corresponding to column 49. After analysis of the code in card column 49 and as a consequence of which the transcription of the code has been determined and will be brought to completion by the zoning and recording units, the clip set in notch "49" of drum 144 closes contacts 172 (see Fig. 32) at "25" of the 49th cycle point.

Closure of contacts 172 forms the following circuit (top of Fig. 34b):

Zero elimination program circuit.—From the right side, through coil R-25 and contacts 172 to the left side.

Coil R-25 closes contacts R-25a to by-pass program drum contacts 172 which are closed only momentarily, through the following circuit:

Zero elimination holding circuit.—From the right side, through coil R-25, contacts R-25a, normally closed R-16b contacts, and to the left side.

Contacts R-16b remain closed till coil R-16 is energized. It will be recalled that coil R-16 is in the intrazone analysis circuit and is energized when any of digits 1 to 9 are sensed in a card column. Thus, upon the occurrence of the first significant digit in the numerical card field, the circuit of coil R-25 will open because of the breaking of contacts R-16b.

Coil R-25, during its period of energization, maintains contacts R-25b (Fig. 34a) open. Contacts R-25b are in the "0" zone analysis circuit, traced previously, and if zero elimination is not desired may be shorted out by a jumper wire 322 (see Fig. 34a). As long as contacts R-25b are open, the "0" analyzing circuit cannot be established, so that any zero codes punched in the columns of the numerical card field will be ignored, and no recording of zeros will take place under control of the zero codes until contacts R-25b reclose. When the first significant digit 1 to 9 is sensed in a column of the numerical field, an intrazone analysis circuit will form, energizing coil R-16 which opens contacts R-16b to break the zero elimination holding

circuit. Coil R-25 thereupon is deenergized, permitting contacts R-25b to reclose, so that any zero code in a column following the first one in which a perforation 1 to 9 is sensed will be effective to cause recording of the "0" designated by the zero code.

Simultaneous card cycle program contacts operation.—The control by clips 147 set on card cycle program drum 144 for individually operating tabular spacing contacts 153, high speed contacts 160, and zero elimination contacts 172 has been explained. It may be desired to operate any two or all three of these program contacts by a common clip 147. Thus, contacts 153 and 160 may be simultaneously operated under control of a double width clip 147 placed with its head closer to the inner flange of drum 144 (the upper flange, as viewed in Fig. 12). The same clip placed with its head closer to the outer drum flange will simultaneously control contacts 160 and 172. A clip with a divided head (see Fig. 12) will simultaneously control contacts 172 and 153. All three contacts 153, 160, and 172 may be simultaneously operated under control of one wide head clip spanning the entire width of the drum (see Fig. 12). Of course, any clip controlling the contacts 160 will preliminarily control contacts 167, as previously brought out.

As an illustration of when all three program contacts are to be simultaneously operated, assume, as in the previous description of the program high speed skip means, that card columns 11 to 20, inclusive, form a skip field to be moved past the analyzing station at high speed and that columns 21 to 30 form a numerical card field, the numerical transcription of which is to be recorded in a list to be spaced by the tabular mechanism of the recording unit from the preceding list, the last character of which is a transcription of the code of column "10," the column preceding the skip field. To effect cyclic or program skipping of card columns 11 to 20, a clip 147 must be set in the drum notch "10" corresponding to the last normal speed column and a second clip in the drum notch "20" corresponding to the last high speed card column, as explained hereinbefore. The first clip may have a narrow, single width head with its active projecting portion in position for engaging only pinion 155a of contacts 160. The second clip 147 will have the widest head adapted to engage pinions 155a and 168 and cam lug 150a simultaneously. The first clip 147 successively traverses pinions 163a and 155a, and in the manner previously explained the turning of pinion 155a closes contacts 160 to initiate high speed action at "80" of the "10" cycle point to skip card columns 11 to 20 at high speed. The second clip actuates pinion 163a to open contacts 167 as card column "15" is traversing the analyzing station, thereby deenergizing high speed clutch magnet 91 to cause the high speed card feed to stop at "80" of the 20th cycle point. After passing pinion 163a, the second clip 147 simultaneously actuates cam lug 150a and pinions 155a and 168. This occurs as card column "20" is still traversing the analyzing station at high speed. The operation of pinion 155 reopens high speed control contacts 160. The operation of cam lug 150a momentarily closes tabulating control contacts 153, and the operation of pinion 168 momentarily closes zero elimination contacts 172.

The closing of contacts 153 closes the previously traced program tabular control circuit

as a consequence of which the coils R—14 and R—15 are energized. Coil R—14 closes the left side of contacts R—14b (Fig. 34a) to form the program tabular circuit, energizing comb magnet 212—11 to cause operation of the tabular spacing mechanism, which results in lateral spacing of the bill form to bring the beginning of the next vertical field or list to the printing position. Coil R—14 also has opened contacts R—14c in the main clutch magnet circuit, so that when the high speed card feed stops at "80" of the 20th cycle point, the main clutch also is uncoupled, causing card feed to stop till the tabular spacing operation is completed.

The zero elimination contacts 172 were also closed during the 20th cycle point, causing the zero elimination program circuit to form, followed by the zero elimination holding circuit, causing contacts R—25b to open. Thus, after the program tabular spacing operation when card feed resumes, the open contacts R—25b prevent formation of "0" analyzing circuits under control of "0" codes in numerical card field columns 21 to 30 until a perforation 1 to 9 is sensed for breaking the circuit of coil R—25, which, in turn, permits contacts R—25b to reclose.

In above manner, all four program contacts 167, 160, 153, and 172 may be commonly operated by a single wide clip 147 to cause restoration of the H. S. skip circuit to initial open condition, the initiation of tabular spacing operation, and the initiation of zero elimination.

If desired, a single wide clip 147 may be set in drum notch "10" for commonly operating contacts 167, 160, 153, and 172 to initiate high speed skipping of card columns, zero elimination, and tabular spacing. This clip will first close contacts 167 at the "5" cycle point and five cycle points later will close contacts 160, 172, and 153. The closure of the latter contacts will occur at "25" of the "10" cycle point (see Fig. 32), the zero elimination holding circuit will form because of closure of contacts 172, the tabular control circuit, energizing coil R—14, will form as a result of closure of contacts 153, and the high speed clutch magnet 91 will be energized as a result of closure of contacts 160. Due to opening of contacts R—14c, the main clutch magnet 53 is deenergized, and the tabular spacing occurs while the card feed is arrested. At the end of the tabular spacing operation, the main clutch magnet is again energized, and with the high speed clutch magnet still energized, the high speed card feed begins to skip columns 10 to 20. The zero elimination control remains in effect until the first significant figure of the numerical field is sensed.

It is clear from the above that instead of all three, any combination of two of the program contacts may be operated simultaneously to control either H. S. skip circuit restoration and tabular spacing or H. S. skip circuit restoration and zero elimination or tabular spacing and zero elimination.

Line space program drum resetting

After a stack of cards T has been run through the machine, before starting the operation on a new stack of cards, the line space program drum 276 should be reset to home or zero position to bring it into correct line relation to the new series of bills to be printed. The resetting of drum 276 is initiated at will by the manual depression of a key 323 (bottom of Fig. 34b) to

close contacts 323'. While the drum is in any intermediate position, contacts 298 associated therewith (see Figs. 1 and 10) are closed. Thus, closure of key contacts 323' with contacts 298 also closed forms the following circuit (bottom of Fig. 34b):

Line space program drum reset initiating circuit.—From the left side, through contacts 298, key contacts 323, a coil R—17, and to the right side.

Coil R—17 closes stick contacts R—17a to bypass key contacts 323' so that the operator may release key 323.

Coil R—17 also opens contacts R—17b of the start key circuit, preventing the undesirable initiation of operations on the new stack of cards while the drum 276 is being reset to home position.

Coil R—17 also closes contacts R—17c which are in parallel with carriage return zoning system lever contacts 247 (near bottom of Fig. 34b). Closure of contacts R—17c energizes line space drum clutch magnet 270 through the following circuit:

Line space drum clutch circuit #2.—From the right side, through magnet 270, contacts R—17c, and carriage contacts 28, to the left side.

Magnet 270 couples driven clutch elements 265—266—267 to driving clutch ratchet 264 (see Fig. 10), causing rotation of drum 276. When the drum reaches home position, arm 299 of the drum driver 275 opens contacts 298, breaking the stick circuit of coil R—17. Contacts R—17c thereupon open to break the circuit of magnet 270, and drum 276 stops in home position.

Checking operations.—It is desirable to check the accuracy of interpretation by the zoning system and the transcribing means of the analyzed codes in the card columns, and to stop card feed if a wrong transcription is detected as having been recorded. For this purpose, the main clutch magnet circuit includes contacts R—27b controlled by a relay coil R—27 (lower right of Fig. 34c). Immediately upon closing of main switch SW, the coil R—27 is energized as follows (Fig. 34c, bottom):

Coil R—27 circuit.—From the right side, through coil R—27 the serially connected normally closed relay points 325b of coils 325—0 to 9, to the left side.

Coil R—27 closes contacts R—27a to by-pass contacts 325b through zoning cycle commutator HS—6 (see Figs. 5 and 32) which is closed during each zoning cycle or revolution of shafts 123 or 39 except for a short interval between "55" and "70." During this interval when HS—6 breaks, the main circuit of coil R—27 must be effective through closed 325b contacts of coils 325—0 to 9, but if any of the latter contacts is open, the main circuit of coil R—27 cannot make and contacts R—27b open to break the main clutch magnet circuit, causing the card feed to stop at "80" of the zoning cycle. Thus, commutator HS—6 breaks between "55" and "70" of each zoning cycle to detect an open condition of any of contacts 325b of coils 325—9 to 0. Contacts 325b of coils 325—9 to 0 stay closed only if the transcription of a code in a card column has been accurately made. If the card column code is not accurately interpreted and recorded, one of contacts 325b of coils 325—9 to 0 will be open and upon opening of commutator HS—6 during the same zoning cycle in which the code was analyzed, coil R—27 is deenergized, causing con-

tacts R-27b to open and break the main clutch magnet circuit.

As brought out in the previous tracing of the analyzing circuits, there is a coil 325 in parallel with each comb magnet 212 and energized simultaneously therewith. Each of coils 325-9 to 0, of the intrazone analysis circuits, is the pick up coil of a double coil relay having a holding coil 325' (right of Fig. 34c). Thus, upon formation of an intrazone analyzing circuit, one of the coils 325-9 to 0 will be energized to open the related b contacts in the main circuit of coil R-27. Coil 325 also closes related contacts 325a to close the circuit through the associated holding coil 325', as follows (Fig. 34c):

Holding coil 325' circuit.—From the right side, through the coil 325' (associated with the energized coil 325), the contacts 325a closed by the latter, one of the contacts 26 (see also Fig. 6) of the recording unit, through the normally closed right side of transfer contacts R-6b, hand switch 326, and to the left side.

The energized holding coil 325' holds contacts 325a closed and 325b of the double coil relay open after the related pick-up coil 325 is deenergized by breaking of the analyzing circuit at about "24" of the zoning cycle. Thus, with contacts 325a maintained closed, the holding coil circuit can be opened only by opening of the contacts 26 therein. Contacts R-6b are controlled by the coil R-6 of the shift magnet circuits, which is energized only upon analysis of an alphabetic code, as previously explained. Thus, during an interzone analysis, the right side of contacts R-6b are closed. Switch 326 may be opened to suppress the holding coil circuits and control by the checking means of the main clutch magnet circuit may entirely be suppressed by shorting contacts R-27b of the main clutch circuit by a jumper 623 (see Fig. 34b).

Each pair of contacts 26 is controlled by a cam 12 (see Fig. 6). As explained in the description of the interpreting or zoning system, operation of a lever 10 unlatches a cam 12 for coaction with power shaft 14, and the shaft rocks the cam to cause the character corresponding to the operated lever 10 to be recorded. As cam 12 is rocked by shaft 14, it opens the related pair of contacts 26. If the zoning and recording means accurately transcribes the analyzed code, the pair of contacts 26 in the circuit of the energized holding coil 325' is opened by the cam 12 which causes the recording operation to take place. Accordingly, coil 325' will be deenergized, permitting its contacts 325b to reclose. The analyzing circuits formed under control of a code in a card column cause the release of one zoning lever 218 (Figs. 7 and 8) for operation by lift bail 221 (see also Figs. 6, 24, and 27). The lift bail elevates the released lever 218 at "50" of the zoning cycle (see Fig. 32), causing operation of the connected lever 10 to release the associated cam 12 for turning by shaft 14. At about "53" of the zoning cycle, the cam 12 has opened related contacts 26, and if the correct transcription of the analyzed code has been made, the correct cam 12 will operate to cause the character accurately corresponding to the analyzed code to be recorded, and as an incident thereto will have opened the contacts 26 in the previously formed circuit of holding coil 325'. Accordingly, the latter coil will have been deenergized to permit its contacts 325b to reclose, making the main circuit of coil R-27 before the commutator HS-6 breaks at "55" to open the stick circuit thereof. Thus, contacts

R-27b will remain closed, causing the card feed to continue uninterruptedly.

If the analyzed code has not been accurately transcribed, the wrong cam 12 will operate, and the contacts 26 in the previously formed circuit of the holding coil 325' will not open. Coil 325' will, therefore, hold its contacts 325b in the main circuit of coil R-27 open, and when commutator HS-6 breaks at "55," coil R-27 will be deenergized, causing contacts R-27b to open and break the main clutch magnet circuit. The main clutch will then disengage at "80" of the zoning cycle, interrupting card feed as an indication of an inaccurate transcription.

To further explain the specific operation of the checking means, assume the number "8" code is in the card column at the analyzing station. Analysis of the "8" hole results in energization of pick-up coil 325-8 and parallel comb magnet 212-8. Coil 325-8 opens contacts 325b-8 in the main circuit of coil R-27 but the stick circuit thereof is still operative through commutator HS-6. Coil 325-8 also closes contacts 325a-8 to make the circuit of holding coil 325'-8 through contacts 26-8, and the latter coil maintains contacts 325a-8 and 325b-8 closed. Comb magnet 212-8 has been energized to move comb 210-8 to the right. This releases one of levers 218 for operation by lift bail 221, as a result of which the associated lever 10 is depressed to cause related cam 12 to be rocked. At about "53" of the zoning cycle, the cam 12 opens the adjacent contacts 26 and then effects operation of the associated type bar 18. If the zoning system, including combs 210 and levers 218, has been properly operated, the lever 218 connected to the lever 10 which causes recording of the character "8" will have been released by the combs and will be operated by lift bail 221. Correspondingly, the "8" cam 12 will have been rocked, opening the "8" contacts 26, thereby breaking the circuit of coil 325'-8. The latter will permit contacts 325b-8 to reclose, so as to close the main circuit of coil R-27, continuing contacts R-27b closed during the open period of commutator HS-6. Thus, the main clutch magnet circuit will remain effective.

If the wrong lever 218 has been operated by the zoning system, then contacts 26-8 will not have been opened, and coil 325'-8 remains effective to open contacts 325b-8, thus causing coil R-27 to be deenergized at "55" of the zoning cycle. Consequently, contacts R-27b open, breaking the circuit of main clutch magnet 53. Coil R-27 remains deenergized until contacts 325b-8 reclose, and, therefore, the main clutch magnet remains deenergized. To reclose contacts 325b-8, coil 325'-8 must be deenergized, and this may be done by manually back-spacing the typewriter carriage, erasing the incorrect figure, and manually operating the correct lever 10 to cause typing of the correct figure. As an incident thereto, contacts 26-8 will open, breaking the circuit of coil 325'-8, causing contacts 325b-8 to reclose, and again resulting in energization of magnet R-29. The latter will then reclose contacts R-27b, starting the main clutch in operation.

When an alphabetic, combination code, is sensed in a card column, a zone analyzing circuit and an intrazone analyzing circuit are formed. The "12," "11," and "0" analysis circuits respectively cause pick-up coils 325-12, 11, and 0 to be energized. Coil 325-12 closes contacts 325a-12 (lower portion of Fig. 34c), coil 325-11 closes

contacts 325a-11, and coil 325-0 closes contacts 325c-0 and opens contacts 325b-0 (in the main circuit of coil R-27), and closes contacts 325a-0.

In addition to the zone analyzing circuit, an intrazone analyzing circuit is formed when an alphabetic code is sensed. The intrazone circuit energizes the intrazone pick-up coil 325 to close its contacts 325a and open its contacts 325b.

The zone and intrazone coils 325 operate in combination to check the accuracy of interpretation of the alphabetic code. As previously described, when an alphabetic code is analyzed, a shift magnet circuit is formed through shift magnet 240 and through parallel coil R-6 in order that the letter be printed in upper case. Energization of magnet 240 and coil R-6 is continued through the shift magnet holding circuits #1 and #2. Coil R-6 also opens the right side of transfer contacts R-6b (Fig. 34c) and closes the left side of the latter. With the right side of contacts R-6b open, the holding coil 325' circuit cannot be formed. This forces the circuit of an intrazone coil 325'-9 to 0 to be routed through the switch 26 corresponding to the letter whose combination code has been analyzed. The magnet 325-12, 11, or 0 selects the route of the circuit for the intrazone holding coil 325' in accordance with the zone perforation combining with the intrazone perforation to form the alphabetic character code. If the character falls within the "12" zone, the coil 325-12 is energized and closes contacts 325a-12, forming a circuit through relay coil 327-12 (Fig. 34c) which is held through stick contacts 327a-12 and zoning cycle commutator HS-5 after the analyzing circuit breaks at about "24" (see Fig. 32). If the character is in the "11" zone, then similar circuits are formed through coil 327-11. If the character is within the 0 zone, then a circuit for coil 327-0 is established through contacts 325c-0, and held through contacts 327a-0 and commutator HS-5.

If coil 327-12 is energized, it opens contacts 327b-12 and 327c-12, respectively, in the "11" and "0" zone lines (upper left of Fig. 34c), preventing routing of the circuit of any intrazone coil 325' through the "11" or "0" zone lines. If coil 327-11 is energized, it opens contacts 327b-11 and 327c-11 breaking the "12" and "0" zone lines. If coil 327-0 is energized, it opens contacts 327b-0 and 327c-0, opening the "12" and "11" zone lines. Thus, in accordance with which code zone the character falls in, only the corresponding zone line will be closed for a circuit through the intrazone coil 325' corresponding to the intrazone characteristic of the alphabetic character.

Assume, as an example, that the "11" zone character "J" has been analyzed. The intrazone characteristic of this character is "1" (see Fig. 30). Accordingly, coils 325-11 and 325-1 are energized. Coil 325-11 closes contacts 325a-11, forming a circuit through coil 327-11 which is held by the stick circuit through HS-5. Coil 327-11 opens its contacts 327b and c to break the "12" and "0" zone lines, leaving only the "11" zone line unbroken. The circuit for the intrazone coil 325'-1 is now routed through the "11" zone line, as follows (Fig. 34c):

Alphabetic coil 325' circuit.—From the left side, through switch 326, the left, now closed side of contacts R-6b, the "11" zone line, the recording unit cam switch 26—J, lines 328, 329, contacts 325a-1 (closed by the coil 325 of the "1"

intrazone analyzing circuit), and coil 325'-1, to the right side.

Energized coil 325'-1 now acts, in the same manner as described in connection with the checking of a numerical character, to cause the card feed to stop if the cam 12—J has not been operated as it should be for correctly interpreting the analysis of the code 11-1 of character J.

While there has been shown and described and pointed out the fundamental novel features of the invention as applied to a single modification, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art without departing from the spirit of the invention. It is the intention therefore to be limited only as indicated by the scope of the following claims.

What is claimed is as follows:

1. In a machine of the class described; the combination of means for feeding records bearing data designations, recording means, means controlled by the data designations of the records for operating the recording means to record the data on a sheet, means for varying the speed of the record feed, means for tabular spacing the sheet, and a program means including a movable part operatively connected to the feeding means for actuation in synchronism with the feed of the records and means coacting with said part for controlling operation of the record feed varying means and the tabular spacing means.

2. In a machine such as described; a program member movable recurrently through a predetermined course of travel and having successive retaining portions, an element settable in any of said retaining portions, switch means for controlling, in accordance with its condition, an operation of the machine and including a pair of separable blades, and a shaft having successive high and low peripheral portions movable between said blades and having means engaged by said element during the travel of said member for turning the shaft to move it from a position in which the high peripheral portion is between the blades and holding them furthest apart to cause the switch means to be in open condition to a position in which the low peripheral portion of the shaft is between the blades and enabling them to come closer together for causing the switch means to be in closed condition.

3. In a machine in which a sheet is line-spaced to receive items on successive lines; means controlled by item representations on record forms for recording the corresponding items along successive lines of the sheet, a device operable to space the items recorded on successive lines of the sheet into separated lists, program control means, means for operating the control means correlatively with the recording along each line, and means controlled by the program control means, separately of any record form representations, for automatically operating said device for each line of recording to effect list separation of the items recorded under control of the item representations on the successive lines of the sheet, according to a predetermined program of list separation.

4. In a machine in which a sheet is line-spaced to receive items on successive lines; means for feeding record bodies in succession, means controlled by item representations on the record bodies to print the items on successive lines of the sheet, a device operable to effect intra-line

spacing of the sheet to cause the items printed on the successive lines of the sheet to be arranged in list form, a program controller, means for synchronizing the action of the program controller with the feed of the record bodies, and means controlled by the program controller for automatically operating said device according to a predetermined program of list separation.

5. In a machine in which a sheet is line-spaced to receive items on successive lines; means to feed record bodies, each bearing item representations, in succession, means controlled by the item representations of the record bodies for printing the items along successive lines of the sheet, a device operable to effect intra-line spacing of the sheet to space the items of the successive lines of the sheet in separated lists, a program controller having a recurrent course of travel, means for effecting travel of the controller in synchronism with the feed of the record bodies, variably settable means on the program controller, and means operated by the variably settable means during each recurrent course of travel of the controller for automatically causing operation of said device according to the setting of said settable means on the controller.

6. In a machine in which a sheet is line spaced to receive items on successive lines; means successively sensing item representations in successive portions of record bodies, mechanism controlled by the sensing means to print the sensed items on successive lines of the sheet, a device operable to effect intra-line spacing of the sheet to arrange the items on the successive lines of the sheet into separated lists, a program control means including one or more control elements located in successively spaced areas and a member adapted to be operated by an element in one of said areas in step with the sensing of a record body portion, means for effecting relative movement between the member and the successive areas in step with the successive sensing of the portions of each record body, and means controlled by operation of said member for automatically operating said device to effect intra-line spacing of the sheet according to the location of the control element in one or another of said areas.

7. In a machine wherein an intra-line spacing carriage is provided for a sheet and wherein means are provided to line space the sheet to receive items on successive lines; means controlled by item designations on successive record bodies for recording the items, one after another, on successive lines of the sheet, a device operable to effect intra-line spacing of the carriage to space the items recorded on successive lines of the sheet into separated lists, a program controller remote and separate from the carriage, means for operating the controller in correlation with the successive recording of items on the lines of the sheet, and means controlled by the controller, independently of the carriage, for automatically operating said device as the carriage reaches a predetermined point of its intra-line travel for each line of item recording so as to cause the items of the successive lines to be arranged in predetermined list form.

8. In a machine wherein line spacing mechanism is provided to line space a sheet to receive items during successive recording cycles on successive lines of the sheet; the combination of means controlled by item equivalents for recording the items along successive lines of a sheet, each line during one recording cycle, a device

operable to cause the items of the successive lines to be spaced in list form, automatic means for effecting operation of said device, means for normally rendering the aforesaid automatic means effective at least once each recording cycle whereby the device is operated at least once for each line of recording, a contrivance, means for operating said contrivance in step with the line spacing of the sheet, and means controlled by said contrivance when a predetermined line of the sheet is in recording position for automatically suppressing operation of said device.

9. In a machine wherein a line-spacing actuating means is provided for line spacing a sheet; the combination with means for recording items along lines of the sheet and a device operable to effect a line-spacing operation of said actuating means, of means for rendering said device recurrently effective to cause the line-spacing actuating means to effect repeat line spacing of the sheet, a traveling controller, means controlled thereby for terminating the repeat operations of said device, a drive for said controller remote from and separate from the line-spacing actuating means, and means controlled by said device upon each operation thereof for causing the drive to actuate the controller in step with the line-spacing of the sheet.

10. In a machine wherein carriage return mechanism is provided to line space a sheet; mechanism to record data on the sheet, a device operable to cause the carriage return mechanism to line space the sheet, means for effecting repeat operations of said device to cause repeated line spacing of the sheet by the carriage return mechanism, means for initiating operation of the repeat effecting means, a settable program controller, means controlled thereby for terminating the repeat operations of said device by the first named means when a particular line of the sheet selected by the setting of the controller reaches recording position, and means for correlating the program controller and the setting thereof with the line spacing of the sheet.

11. In a machine wherein carriage return mechanism is provided to line space a sheet; mechanism to record data on the sheet, a device operable to cause the carriage return mechanism to line space the sheet, means for effecting automatically successive repeat operations of the device to cause multiple line spacing of the sheet by the carriage return mechanism, means for initiating operation of the first-named means, a settable program controller, means controlled thereby for controlling the continuation of operation of the first-named means in accordance with the setting of the controller, and means for correlating the controller to the line position of the sheet.

12. In a machine controlled by a record body in accordance with designations thereon and including carriage return mechanism to line space a sheet; the combination of mechanism to record data along lines of the sheet, a device operable to cause the carriage return mechanism to line space the sheet, means initiated in operation by a designation of the record body for effecting automatically successive repeat operations of the device to cause multiple line spacing of the sheet, a settable program controller, means controlled thereby for controlling continuation of the repeat operation of said device in accordance with the setting of the controller, and means for correlating the program controller and the setting thereof with the line position of the sheet.

13. In a machine controlled by designations on a record body and including line spacing mechanism for a sheet; the combination of mechanism to record items along lines of the sheet, means, operation of which is initiated by a designation of the record body, for controlling the line spacing mechanism to effect multiple line spacing of the sheet, a settable program controller movable in one continuous direction and having repeat cycles during such movement, means controlled by said controller during each said cycle for controlling the first-named means to govern the extent of multiple line spacing of the sheet in accordance with the setting of the controller, and means for moving said controller in step with the line spacing of the sheet.

14. In a machine for recording data in longitudinally spaced fields of a sheet; the combination of a device operable to cause the spacing of the sheet from one such field to the next, means for effecting operation of the device to cause said sheet spacing, a rotary program drum having elements selectively settable thereon, means controlled by said elements during rotation of the drum and in accordance with the setting of said elements for controlling effectivity of the first-named means, and means controlled by said device, upon operation thereof, for rotating said drum in step with the spacing of the sheet.

15. In a machine for recording data on a sheet; the combination of means for feeding record forms bearing data and control designations, means controlled by the data designations of the record forms for controlling the machine in recording the data on the sheet, program means including a movable part operatively connected to the feeding means for actuation in synchronism with the feed of the record forms and means coacting with said part to control a desired programmatic operation of the machine, supplementarily to control thereof by the data designations, sheet-spacing means, a program device for controlling operation of the sheet-spacing means in effecting a predetermined spacing of the sheet, means controlled by a control designation of a record form for initiating operation of the sheet-spacing means under control of the program device, means for advancing the program device in step with the spacing of the sheet, and means under control of the program device for interrupting feed of the record forms and actuation of the aforementioned part of the program means while the sheet is being spaced.

16. In a cyclical machine for recording data on a sheet and acting during successive record cycles on successive records bearing data and control designations, the combination of means controlled by the data designations of the records for controlling the machine in recording the data on the sheet, program means including a movable part and means coacting therewith to control a predetermined programmatic operation of the machine, supplementarily to control thereof by the data designations, cyclical means for actuating said part each record cycle to coordinate the control by the program means with the cycles of action of the machine on the records, sheet-spacing means, a program device for controlling operation of the sheet-spacing means in effecting a predetermined spacing of the sheet, means controlled by a control designation of a record for initiating the operation of the sheet-spacing means under control of the program device, means for advancing the program device in step with the spacing of the sheet, and means under control of the pro-

gram device for interrupting operation of said cyclical means while the sheet is being spaced.

17. In a machine for acting on a plurality of successive records bearing codal representations, the combination of means for feeding the records in succession through the machine, a recording unit for recording on a sheet remote from the records, means controlled by the codal representations for causing the recording unit to record the equivalents of the representations on the remote sheet, program means, including a movable part operatively connected to the feeding means to be actuated in step with the feed of the records and means coacting with said part recurrently, once for each of said successive records fed through the machine, for alternatively and additionally controlling a predetermined programmatic operation of the recording unit, irrespective of any codal representations on the records, according to a selected program.

18. In a machine of the class described, means for feeding a record having an idle field followed by a data field, means to sense data designations in said data field, means controlled by the sensing means for recording the sensed data in an allotted portion of a sheet, tabular spacing means for bringing the allotted portion of the sheet to recording position, means for skipping the idle field with respect to the sensing means, means for operating the skipping means, means for operating the tabular spacing means, and means under control of the tabular spacing means for suppressing skipping operations while the tabular spacing operation is taking place to prevent premature sensing of the data field before the allotted portion of the sheet is brought to recording position.

19. In a cyclically operating machine acting each cycle on each of successive records bearing item representations; the combination of means controlled by the item representations of the records for recording the items, means for spacing the items apart in a suitable direction, cyclically operating control means, means controlled thereby for normally effecting each cycle, a cyclical operation of said spacing means, settable means for suppressing said cyclical operation of the spacing means during a cycle selected by the setting, and means for correlating the suppressing means with the cycles to render the latter means effective during the selected cycle.

20. In a machine acting on successive records bearing function-control designations; the combination of variable speed mechanism for feeding the records successively through the machine, means controlled by the designations of the records for manifesting the designated functions, control means including a part operatively connected to the feeding mechanism for actuation in synchronism with the feed of the records and related means coacting with said part recurrently, each recurrence for each of successive records acted upon, means controlled by the coaction of said part and said related means for varying the speed of the feeding mechanism during the passage of a predetermined portion only of each of said successive records through the machine, and means governed by said control means for suppressing control of the manifesting means by any designations which may be in the aforesaid predetermined portions of the records.

21. In a cyclically operating machine for acting each cycle on each of successive records bearing designations; the combination of means for operating on the records in succession, variable speed means for feeding the records successively

through the operating means, cyclically operating control means, means controlled thereby for normally causing the feeding means, each cycle, to vary the speed of feed through the operating means of a portion of each record, settable means for selectively suppressing the control of the speed variation during a cycle selected by the setting, and means for correlating the suppressing means with the cycles to render the latter means effective during the selected cycle.

22. In a machine having longitudinal spacing mechanism for spacing a sheet between successive lines of recording; means to record items successively along a line of the sheet, means to effect intra-line spacing between successively recorded items, control means normally causing the intra-line spacing means to operate at a desired point of each line of recording to effect a predetermined intra-line spacing, means for operating the control means in step with the successive recording on each line, a control device for selecting a line of recording in which said intra-line spacing is to be suppressed, means for correlating the control device with the arrival of the lines of the sheet at recording position, and means controlled by said control device upon arrival of the selected line of the sheet at recording position for suppressing only said predetermined intra-line spacing whereby the recording of items takes place along the selected line unaccompanied by the aforesaid intra-line spacing.

23. In a machine in which a sheet is line spaced to receive items on successive lines, recording means for recording items successively in each of successive lines of the sheet, means controlled by item designations on record forms for causing the recording means to record the items successively, means for effecting intra-line spacing of the sheet and recording means relatively to each other to space the items recorded on successive lines into separate lists, program control means separate from the record forms, means for operating the program control means in correlation with the successive recording on each line of the sheet, and means controlled by the program control means for automatically operating the intra-line spacing means at a selected point of each line of recording on the sheet.

24. In a machine in which a sheet is line spaced to receive items on successive lines, means for successively sensing item designation of records, means controlled by the sensing means for recording the items on the successive lines of the sheet, means for effecting list separation of the items recorded on the successive lines of the sheet, program control means separate from the records and including relatively movable cooperable contrivances, means for moving the contrivances relatively to each other in step with the successive sensing of the designations of each said record, at least one of said contrivances being settable according to a selected program of list separation, and means controlled by the coaction of the contrivances, separately of the records, for automatically operating the separation-effecting means for each line of recording to effect said list separation according to the selected program.

25. In a machine in which a sheet is line spaced to receive items on successive lines during each of successive recording cycles, means controlled by item representations of records for effecting cycles of recording, each cycle to record represented items along one line of the sheet, means for effecting list separation of the items on the lines, control means separate from the records for con-

trolling operation of the separation-effecting means, means for operating the control means correlatively with the recording cycles, and means controlled by the control means for operating the separation-effecting means recurrently, at least once for each recording cycle, to effect said list separation of the items of the successive lines.

26. In a cyclically operating machine in which a sheet is line spaced to receive items on successive lines, means for sensing records, one each cycle, for item representations, means controlled by the sensing means for recording the items on the lines of the sheet, means for effecting list separation of the items on the successive lines of the sheet, control means separate from the records, means controlled by the control means for operating the separation-effecting means, and cyclical means for operating the control means to cause the separation-effecting means to operate recurrently, at least once each cycle.

27. In a machine for recording items on successive lines of a sheet under control of item representations in columns of records, means for sensing the columns of a record in succession for item representations, means for presenting the records successively to the sensing means, means controlled by the sensing means for recording the items on the successive lines of the sheet, program control means separate from the records and including relatively movable, cooperable contrivances, means for moving the contrivances relatively to each other in step with the successive sensing of the columns of each record body, at least one of said contrivances being selectively settable according to a desired program of list separation, tabular spacing means for separating the items recorded on the successive lines into spaced lists, and means controlled by the cooperation of the contrivances for operating the tabular spacing means according to the desired program to effect the separation of the items on the successive lines into lists.

28. In a machine in which a sheet is line spaced to receive items on successive lines under control of item representations in columns of records, means for sensing one column at a time, means for presenting the records successively to the sensing means, means for effecting relative movement between the sensing means and the presented record for causing the columns of the record to be sensed successively for representations, typing means for typing items in succession on each line of the sheet, means controlled by the sensing means for operating the typing means to type the represented items of each record, tabular spacing means for tabular spacing the sheet and typing means relatively to each other, program control means including relatively movable coacting contrivances, means for moving the contrivances relatively to each other in synchronism with the relative movement between the sensing means and each successively presented record body, at least one of said contrivances being settable according to a selected program of tabular spacing, and means controlled by the coaction of the contrivances for effecting operation of the tabular spacing means to separate the items on the successive lines of the sheet into spaced lists according to the selected program.

29. In a machine wherein typing mechanism is provided to type items in succession on a line of a sheet and wherein longitudinal spacing mechanism is provided to space the sheet transversely to the lines of typing; means controlled by successive designations of a record for operating

the typing mechanism to successively type items corresponding to the designations, means for operating the longitudinal spacing mechanism, a controller settable to select the line position to which the sheet is to be longitudinally spaced, means for correlating the controller and the setting thereof to the line position of the sheet, and means jointly controlled by the controller according to the setting thereof and by a record designation for controlling said operating means to cause the longitudinal spacing mechanism to space the sheet to the selected line position.

30. In a machine wherein typing mechanism is provided to type items successively on a line of a sheet and wherein longitudinal spacing mechanism is provided to space the sheet transversely to the lines of typing; means controlled by successive item designations of a record for operating the typing mechanism to type the items successively on the sheet, means for operating the longitudinal spacing mechanism, control means separate from the record and settable according to a desired line position of the sheet, means for correlating the control means, according to its setting, to the aforesaid line position, and means under control of the settable control means for rendering the operating means effective to operate the longitudinal spacing mechanism to space the sheet to the aforesaid desired line position.

31. In a machine controlled by designations on a record body and including line spacing mechanism; the combination of means for successively sensing columns of a record for designations, means controlled by the sensing means

for recording items corresponding to sensed designations on the sheet, means for operating the line spacing mechanism to effect multiple line spacing of the sheet, a control element effective as a particular column is being sensed, means for rendering the control element effective as the particular column is being sensed, and means jointly controlled by the control element when effective and by a space designation in said particular column for causing the operating means to operate the line spacing mechanism to effect multiple line spacing of the sheet.

32. In a machine wherein line spacing mechanism is provided to line space a sheet; the combination with means to record items along lines of the sheet and a device operable to cause the line spacing mechanism to line space the sheet, of program means including relatively movable cooperating contrivances, means controlled by the program means for controlling a program operation of the machine, actuating means for moving the aforesaid contrivances relatively to each other, electromagnetic means for controlling the actuating means to effect the relative movement between the contrivances, a circuit for the electromagnetic means, and means for operating the circuit upon each operation of said device to cause the electromagnetic means to control the actuating means for moving the contrivances relatively to each other in step with line spacing of the sheet.

CLAIR D. LAKE.
FRANCIS E. HAMILTON.